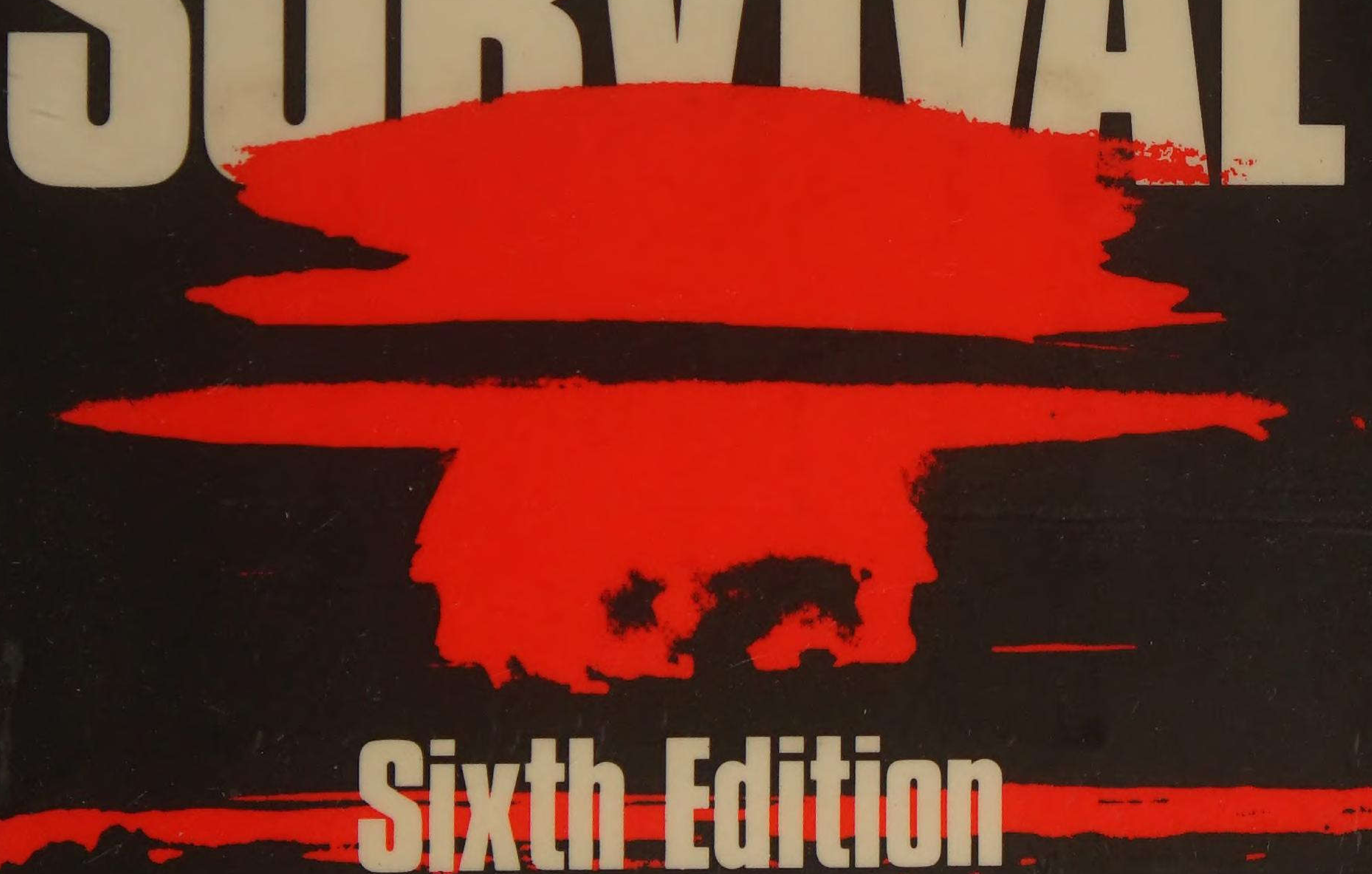
Duncan Long

NUCLEAR WAR SURVIVAL



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Duncan Long

NUCLEAR WAR SURVIVAL

Sixth Edition

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NUCLEAR WAR SURVIVAL by Duncan Long

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Sixth Edition

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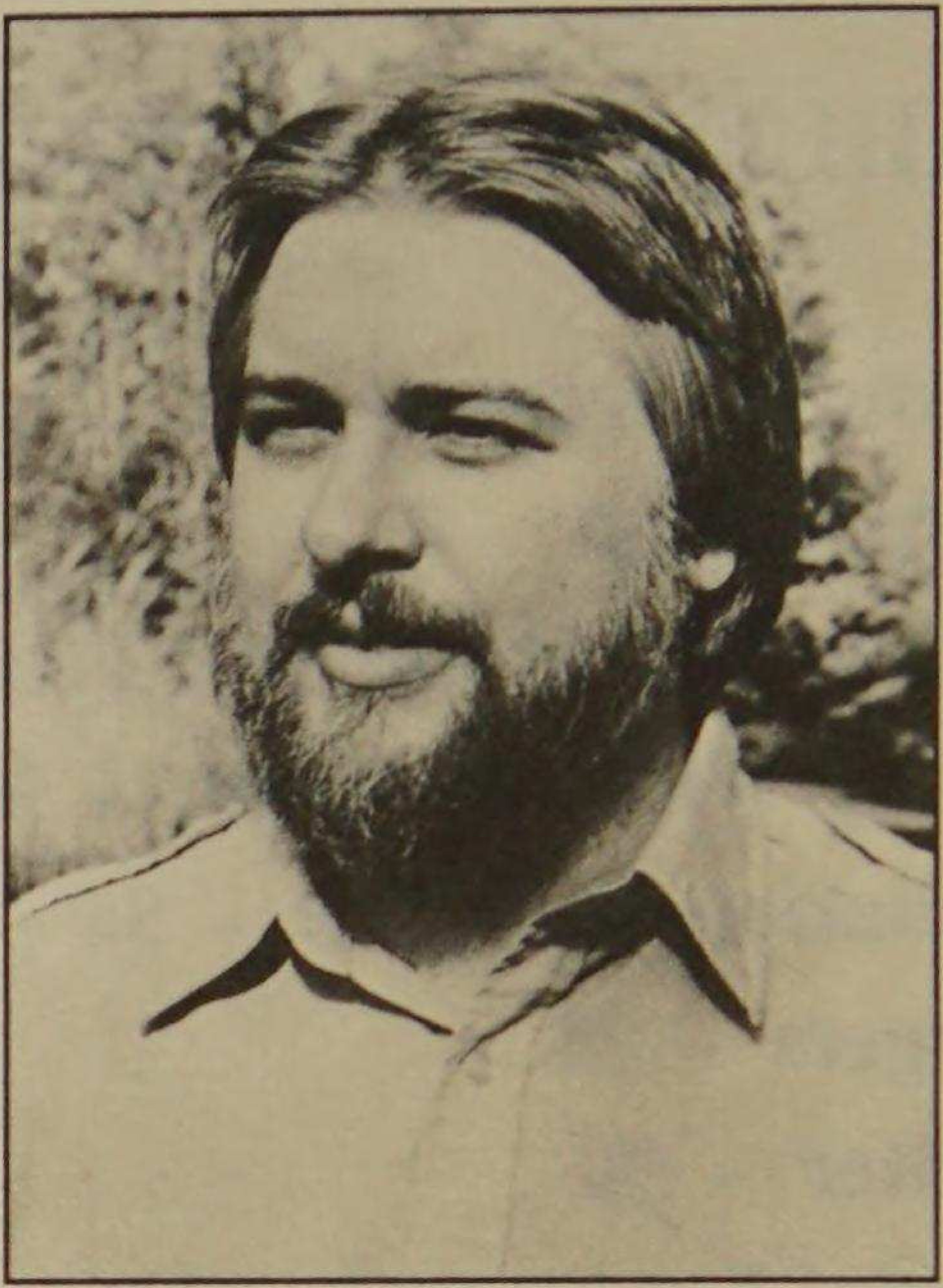

ABOUT THE AUTHOR

Duncan Long is internationally recognized as a firearms and survival expert, with more than eighteen non-fiction books currently in print. He has written numerous magazine articles for the ***Journal of Civil Defense***, ***Gun Digest***, ***American Survival Guide***, and ***Survive***. He also edits **"DIRECTIONS"**, a self-sufficiency/survival newsletter. In addition to his non-fiction writing, the author has written a science fiction novel, ***Antigrav Unlimited***, and is working on a Military/Adventure series that will soon be in print.

Long was born in Smith Center, Kansas, in 1949, and now resides in eastern Kansas with his wife and two children. He earned a BA degree at Sterling College and an MA in music composition at Kansas State University. Long spent nine years teaching in public schools and also worked as a rock musician, proprietor of a mail-order business, youth director, and mail carrier, among other things. Currently he spends most of his working time writing, editing, and researching. The author's hobbies include target shooting, gunsmithing, and watching movies.

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I must extend my thanks to the many readers who have sent in information for this book. Thanks must go to the companies that so graciously loaned (or even gave) equipment to me for testing out during the writing of this book.

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And, as with previous editions of this book, thanks must go to my family: Maggie, Kristen, and Nicholas. They've learned to ignore the insanity of dust masks, radiation suits, freeze-dried food, radiation meters, firearms, assorted equipment, and piles of reference materials—not to mention the ravings of a mad man—while I worked to get this book finished and new editions updated.

INTRODUCTION

Nuclear war. It conjures up all sorts of images—often not very accurate ones. If you think a nuclear war would spell the end of the human race, I hope you'll read this book with an open mind. While no one is going to survive a direct hit from a nuclear bomb, as we'll see in later chapters, the area involved in "total destruction" is not as large as many seem to believe. And research done by many countries and individuals has proven that even a wide-spread nuclear war IS survivable, provided you think about the unthinkable and make a few plans and preparations before the fighting starts.

On the flip side of things, surviving a nuclear war would not be a picnic. It would be bad. But it could be survived and the survivors would NOT necessarily envy the dead—provided the living had planned on surviving before hand.

How likely is a nuclear war?

No one knows except perhaps the guy that actually gives the order to start the ball rolling. But weapons stockpiles have grown and the saber rattling in both the East and West does little to promote pleasant dreams. Too, the rapid build up that took place in the USSR during the SALT I agreement does little to make one feel that treaties are more than hollow hopes.

For those that feel that the Soviets tend to take advantage of their opponent's weaknesses, the contrast between Soviet and US civil defense preparations does little to ease any worries of nuclear war.

The USSR civil defense program is headed by a deputy minister of defense; it has 115,000 full-time personnel involved in it, and its annual budget is in the neighborhood of $2 billion (with many "volunteers" not being paid for their services). Furthermore, nation-wide exercises are held and each citizen is required to attend a 20-hour course on civil defense each year. Special school programs and TV shows round out the teaching to keep the Soviet public aware of the various techniques of surviving a nuclear (or chemical) war.

Topping the Soviet program is a massive system of food storage, blast shelters in many of the Soviet cities, some planned spreading of their industrial complexes to create smaller target areas, and a somewhat crude evacuation program which is rapidly being replaced by in-place public shelters.

In 1980, Richard E. Pipes, a Harvard historian and former director of the University's Russian Research Center, said, "The Soviet Union believes that in the event of a major diplomatic crisis which may lead to war—in the event the US places its forces on high alert—a preemptive nuclear strike is a necessity. I think their forces are fashioned for this kind of a strike."

One can't help but wonder if such a preemptive strike might also be called for if the SDI (Strategic Defense Initiative, often called "Star Wars" by detractors) system looks as if it may be deployed. Would the Soviets try a last-minute strike before the US system is in place? Unfortunately, the SDI system may actually make things more dangerous before they become better.

And there's terrorism. Since a number of Third-World countries seem to be working on their own nuclear weapons, and since terrorists may one day go "big time" with such a weapon, there is always the possibility that a very limited attack using nuclear weapons could occur. A recent UN report covered by the GLOBE AND MAIL of Toronto tells that the material for a 20 KT plutonium bomb "needs be no larger than a man's fist." It would seem that the age of the suitcase nuclear bomb is here. And the old theory that it takes a lot of special know-how to create a bomb was pretty well disproved by the PROGRESSIVE magazine's infamous plans and information on how to brew a basement nuke.

What can you do?

Well, you can store a stockpile of cyanide pills as some peace activists have suggested. But frankly, I suspect that the people who actually follow through with such suicidal plans in an emergency would be few and far between. It's one thing to talk; another to take a brave step to do something suicidal. No doubt those who are now of the "cyanide pill mentality" will be alive and well represented among those who survive to become beggars following a nuclear conflict.

The other choice is to survive with some amount of "style" rather than become a pawn in a nuclear game or become tossed about by the whims of those who come out on top in your local government following a nuclear exchange.

Years ago, when I first got married, I started worrying about more than just what I'd do the next day. Life insurance, house insurance, health insurance, and retirement funds all started to be important. And somewhere along the line, my wife and I discussed nuclear war and I spouted the usual media cliches about the earth being radioactive for centuries and everyone having cancer. Who'd want to live to see that? End of discussion.

For some reason, however, I became curious as to how bad things really would be. A year later, after wading through government charts, military manuals, civil defense booklets, and research reports, I reached—to me—a surprising conclusion: a person COULD survive a nuclear war IF some preparations had been made before a war broke out and he knew exactly what to do when the fighting started.

Unfortunately, at that time, such information hadn't been shared with the general public. There were several reasons for this. There was a need to maintain detente and the MAD (Mutual Assured Destruction) philosophy where East and West kept their civilian populations as hostages. Neither side could allow a viable civil defense program if it were to work. Also, a new SALT Treaty and the aftermath of the Vietnam War had put pressure on the US Government to try to be seen as a peace maker rather than preparing for war in any manner. Finding that a person could survive a nuclear war was like discovering the secret to eternal youth. With my "secret" array of information on how to survive a nuclear war, I started making meager preparations so that my family could survive even if the government wasn't going to help us in our efforts. Soon, I felt guilty. (Remember, this was back before "survivalism" was becoming popular and there were no how-to books about surviving a nuclear war—except those written during the late fifties and early sixties). At the time, no one was letting people know about what a nuclear war would really be like.

So I wrote what amounted to a pamphlet with a thyroid condition, dipped into savings, launched my own publishing/mail order business to sell my publication, put some classified ads in a few magazines, and tried to spread the facts. In the process, I escaped a dead-end job (but also used up the money in my retirement fund to fully finance the business) and finally became a full-time, free-lance writer.

At about the same time, a lot of other people had made much the same discovery that I had. The survival movement sprung up practically overnight as my first ads hit the magazines.

For the first three years of my publishing business, I revised my pamphlet until it finally became a full-fledged book. As I encountered more information, the book grew and became a very useful tool for those interested in surviving. Other authors were writing other nuclear war survival books (often suspiciously like mine) and many of these books were quite good. But...

But none of the books seemed to cover ALL the points that I like to see covered and some were full of errors. EMP, firearms, nuclear winter, the need for good ventilation systems, or what might happen AFTER you've survived a war and what you needed to rebuild your life were all left out or got short shrift in the various books.

Thus, I've continued to update and revise this book, hoping it will fill some important niches in your survival planning and will be the key to finding sources of good information and equipment as well. I've tried NOT to fill it with trivia or useless photos; I have done my best to put in the information that could make the difference between your success or failure in trying to survive a nuclear war. Wherever possible, I've given the source and price for equipment with each company's full address in the appendix (nothing is more frustrating than to read of something you want and not be able to find it).

If you wish to do something besides go wherever the winds of war blow you, then this book is for you. As you read it, remember that people have actually survived disasters that created conditions which were probably worse than an atomic war might create (WITHIN the limited general area where the people lived). The Black Death of the Middle Ages (which claimed one out of three people in Europe and started the Renaissance for the survivors), the Pilgrims' loss of half their number the first winter in America, the Nazi's butchering of the Jews in WWII, and the brutal purges of Stalin and the Cambodians have all ravaged some areas more completely than a nuclear attack would. If you drop back even further into prehistoric times, ice ages which enveloped whole continents and made a number of animals extinct must have put a lot of pressure on the few humans who survived.

The only real difference between any of these disasters and a nuclear war would be in the scope of the disaster. Rather than happening in limited areas, an all-out nuclear war would effect whole continents and—to some degree—the whole world.

While many Western European countries are making serious preparations to survive a nuclear war, in the US surviving a nuclear war is a sort of an every-man-for-himself proposition. Currently, the US Government's civil defense planning is inadequate to meet the needs of its population and contains fatal flaws in some areas. Coupled with Murphy's Law ("Anything that can go wrong will") which seems to accompany war and disaster, it's doubtful that the US will do more than flounder at a national level if a nuclear war should occur.

As we'll see later, it's also possible to accidentally survive a nuclear war. Those who fail to prepare may end up groveling for the tidbits given out by neighbors or whatever government emerges to pick up the pieces. Forced labor, starvation, and lingering illness will be the high points for many of those people who refuse to prepare for the worst and become virtual slaves in its aftermath. You don't have to face such a fate.

And you don't have to spend your life's savings to prepare to survive a nuclear war. I've assumed throughout this book that you aren't made of money. There are simple ways of preparing to survive without spending a huge amount of money to do so. And just as you don't buy a huge insurance policy outright but rather pay small installments on it, so, too, you can make your preparations a little at a time (though if it looks like a war is eminent, you might wish to use a charge card to get ready in a hurry!).

But you do need to start. Do a little crude budgeting and do a little studying and thinking. It's painless and actually will help you sleep a lot better at night since you won't have to worry about so many "what if's" (this may be why people with life insurance live longer than those without it!). Knowing you have a good chance of surviving the worst that mankind might dish out is pretty comforting.

So read this book and don't put off your preparations. Every little bit you do in the next few days will improve your chances for surviving a nuclear war. Start by getting ready to survive—because it may be later than you think.

FALSEHOODS, MYTHS, AND FICTION

Since the first nuclear weapons were made known to the public, there have been a lot of fallacies bandied about as facts and a lot of panels of "experts" explaining misinformation as fact to all of us. Many of these errors are created by well-meaning anti-nuclear war speakers and writers who have few hard facts and a lot of fears and misconceptions. At the other end of the spectrum, the "hawks" aren't a lot better; they often make a nuclear war sound like a picnic. Unfortunately, leaders in both groups are often poorly informed about the physics of nuclear weapons and are "schooled" in the rhetoric of their movement rather than by scientific facts.

Other fallacies occur when fiction writers and movie makers don't take the time to find out the facts—and maybe could care less—about what a nuclear war would be like.

Add a little political/military "disinformation," and you have a real mess of falsehoods, myths, and fiction.

What is often forgotten, especially in the US where most citizens haven't seen the ravages of battle, is the fact that ANY war is terrible. Although most informed people in the 20th Century have stopped (for the most part) believing in the sanitized glory with which our Victorian forebears painted war, the other extreme of making war into something unspeakable and unthinkable does a grave disservice to most people as well. Both extremes create dangerous climates and lead to poor public policies. The Victorians' imagery created wars for little reason while the populous gladly sent their sons to a "hero's death" or mutilation; the last few decades have created the other extreme in a society that might surrender at the first threat of war rather than stand up for human rights and freedom—and chance the loss of their color TV sets.

With these facts in mind, let's first dispel some misinformation about nuclear war which has been created over the last few decades:

First, would the radiation of a nuclear war create mutations in the general population or in animals?

Radiation does cause mutations. But most people don't have too good a grasp of just what all is entailed in a mutation. A mutation is a sudden change in a plant or animal's genetic makeup so that a trait is created which can be inherited by successive generations. Most—if not all—known mutations are detrimental to the organism in which they occur. So detrimental that they usually lead to the death of the mutant.

Sci-fi portrayals of mutants as creatures which have two heads, are telepathic, etc., are certainly entertaining and have put the box office bucks into the pockets of Hollywood film makers. But such fiction doesn't reflect what actually occurs in nature.

Real mutations are always caused by missing traits or failure of a fetus to fully develop. These manifest themselves in a lack of body parts, lack of pigmentation, cleft palate, etc. Thus, one could expect birth defect-style mutations; two heads or the like do not and would not happen.

A "missing link" which leads to a new life form has NEVER been created by exposure to radiation (much to the disappointment of Evolutionists) even though literally millions of laboratory animals have been "mutated" in modern experiments in an effort to create such an animal.

Adding to this is the fact that human beings are even less apt to suffer from radiation-induced mutations than many plants and animals. This is because the human body's reproductive system "shuts down" when exposed to massive amounts of radiation. This sterility acts as a mechanism to prevent gross mutations after exposure to radiation. (Interestingly, research and studies of workers who were accidentally exposed to high levels of radioactive contamination in the nuclear industry indicate that sterility—though it may last for several years—is only temporary in most cases.)

A large body of information has become public during the last decade showing what we could expect in the way of radiation damage following a nuclear war. The Radiation Effects Research Foundation (RERF) has collected data from the two Japanese populations involved in the nuclear bombs used in World War II. (It should be noted that those who argue that nuclear weapons are too awful to ever be used have a definite problem with the history of WWII.)

The RERF research from the Hiroshima and Nagasaki blasts indicates that few—and perhaps no—genetic mutations were created by the two blasts. Of 70,000 pregnancies since the late 1940's among those who were in the Hiroshima/Nagasaki area, there was no increase of still births, birth defects, or infant mortality when compared to other populations who weren't exposed to massive radiation. Though the survivors have chromosome breaks, rings, and other malformations which were caused by their exposure to the bomb's radiation in their own cells, their children have normal cells. There are NO known genetic changes—created by the nuclear blasts—which have been passed to the offspring!

There were several DOZEN (not hundreds or thousands as some anti-nuclear speakers suggest) microcephalic children born following the explosions. These were caused by direct exposure of the fetus to radiation, however, not through genetic damage sustained by the survivors of the two attacks.

Nuclear weapons are horrible. But genetic damage passed from one generation to another does not seem to be one of the prices paid by the survivors of a nuclear explosion. Following a nuclear war, new generations of people would have no extra genetic problems not faced by the current population.

Leukemia?

In the same RERF study, there was a higher incidence of leukemia. But again, not in the numbers you may have been led to believe. The way the information is generally stated by peace activists is that the leukemia rate increases 30 or 40 times. That sounds and is bad and the amount of the increase is true. But the key fact that should be kept in mind is that the normal occurrence of leukemia is only 2 or 3 people from an average group of 100,000 people.

This means that an increase of even 40 times for a population exposed to high levels of radiation would only be slightly more than one tenth of one percent or about one person per one thousand. This would be an unfortunate increase, but hardly overwhelming when one stops to consider the actual numbers involved.

The overall cancer rate also increased in the RERF study. Again, it's not as serious one might think when first looking at percentages. Of the 380,000 people studied by the RERF, the estimate was that there were only 500 additional deaths from radiation-induced cancer. That's less than 2 tenths of a percent increase.

On the flip side of things—and never covered by most of those critical of the idea that nuclear war could be survivable—is the fact that the RERF found that survivors had a lower death rate from non-cancerous diseases and did not suffer from a higher than normal number of diseases. This lower death rate is a mystery. Some conjecture has been made that those who survived the two nuclear blasts were stronger, more resistant people and are, therefore, more resistant to disease. However, one might also argue that the exposure to radiation has a long term effect of reducing the incidence of some diseases.

During the mid-1980's, a number of people have charged that the US Government's estimates of how dangerous various levels of radiation are, have not been conservative enough. These critics have pointed to the apparent numbers of radiation-related diseases and deaths that have resulted to the 42,000 servicemen who took part in the two military exercises held in conjunction with the nuclear tests at Bikini Island in 1946.

If fact, the radiation readings and estimated exposure the troops took appears to have been grossly underestimated. While the Defense Nuclear Agency found no evidence that overexposures had taken place, a separate study done by the General Accounting Office in the mid-1980's found that the military had made a number of serious errors.

Among the errors: the badge dosimeters used were not reliable for measuring both beta AND gamma radiation (gamma radiation being much more dangerous); no allowances were made for badge errors (which were believed to range up or down by 30 percent of the shown reading); errors of plus-or-minus 100 percent may have been made in taking the readings of the badges; large numbers of workers were not monitored for radiation exposure at all; some troops had open wounds which may have given them much higher doses of radiation; decontamination was very poor (and perhaps all but non-existent for many); and the Defense Nuclear Agency probably underestimated internal exposure to radiation by a factor of 10.

So these "tests" were grossly failed and can not be considered to be indicative of anything other than the fact that people who take adequate precautions can survive quite close to a nuclear explosion.

It should also be remembered that many cancer deaths occur without abnormally high exposures to radiation. When a TV news team goes out and finds a number of those involved in various nuclear tests of the 1950's and then "discovers" that many of them have cancer, the news reporter seldom tells how the percentages compare to those of the general population or attempts to discover if the cancer might be caused by pollutants in the area the person is living, poor diets, etc. In fact, we don't even know WHY cancer develops in some people and not others. We shouldn't be mislead by poor research or by single, undocumented instances which prove little but make nice fillers for the evening news.

How long would a nuclear war last?

Often articles or reports describe a nuclear war as being fought in a matter of minutes or even of everyone waking up one morning and finding that there has been a preemptive first strike by one of the super-powers and the war is over.

In fact, nuclear explosions are very bright. Anyone anywhere in a country being attacked would probably be awakened by the light—many times brighter than the sun—which nuclear explosions would produce. (Even if someone were asleep in a windowless room, chances are that the outcry from those in the neighborhood would be enough to awaken him.) Unless you've OD'd on sleeping pills, you probably won't sleep through even a very limited nuclear war.

The "lightning war" that's over in a few minutes seems to be the dream of the 20th Century. Every war is going to be over in a few weeks but stretches over years. There is no reason to believe that a nuclear war would be fought in minutes rather than years. Waves of attacks might occur over weeks or months at the least and even if nuclear weapons were used only initially, it is hard to imagine one side starting a war and not following up with an invasion and the use of chemical or biological weapons. A war that is settled by using only nuclear weapons for a few days is a doubtful proposition.

Things wouldn't be "business as usual" afterward, either. Following such a war, small, resource-rich countries—untouched by war—might emerge as the new super powers of the world. Since the US and Canada feed much of the world, it is also probable that world-wide famine would take place and problems not even conceived of may take place.

On a smaller scale, it is possible that the US Government might be "decapitated" by a number of terrorist nuclear devices being set off in Washington, DC, when Congress and the President were in town. Could democracy survive the chaos and martial law that followed? Would floods of immigrants sneak into the US from Central America to take advantage of the confusion? What type of follow-up would the country initiating the terrorist attack use?

Preemptive strikes? This is another matter of conjecture and, at the current state of technology, is a doubtful proposition. To carry out a preemptive strike that would totally disable another country's ability to fight back, an attacker would first have to have everything timed very carefully or else face a massive counterattack. All planes, ICBM's, and submarine-launched missiles would have to arrive on target at the same time and not alert an enemy of the attack despite the fact that some weapons would have to be launched well before others were because of the differences in the speed of the weapons and the distances of travel.

Even if all this were possible to coordinate, and the first weapons launched weren't detected by spy satellites or radar, and all the weapons worked flawlessly, there's the problem of fratricide.

Fratricide has to do with warheads destroying their "brother" warheads with their nuclear blasts. The initiator explosive of a nuclear weapon has to be very precisely placed on the warhead in order to compress the nuclear material of the bomb and create a chain reaction; the blast created by another nearby nuclear explosion can create enough blast to disrupt an initiator. In such a case, the disrupted initiator may fail to cause a chain reaction making it an expensive dud.

In areas with groups of missile silos, a number of warheads must be used to destroy each of the hardened targets. This means that all the warheads have to impact at the same moment.

Another problem in massing a preemptive strike is that the accuracy needed for a "surgical" attack would also be very high. While newer missiles are becoming ever more accurate, many experts doubt that missile warheads on current ICBM's are THAT accurate since the last half of a warhead's journey is a ballistic arch. During this leg of its journey, the warhead has no power to adjust its flight for targeting errors. Wind, rain, thunder storms, etc., could all cause the warhead to go off course to varying degrees as it drops back into the atmosphere.

Another assumption needed for a preemptive strike is that all the weapons will work nearly flawlessly at the same moment of launching. Because of the problem of fratricide, there is no room for a follow-up shot without risking a counter attack by an enemy. Given the problems of launching one space shuttle or coordinating minor military attacks with conventional weapons, is it likely that either the US or USSR could launch an attack and expect all their weapons to function flawlessly? This is a little hard to buy. Any weapon which failed on the preemptive strike would allow the country being attacked to launch a weapon back at the attacker.

Looking at things from the other side, SDI (Strategic Defense Initiative) tries to prevent an attack—preemptive or otherwise—by blasting warheads out of the sky before they reach their targets. In many ways, this might be a realistic goal since there are a number of times when the missiles and warheads might be attacked as they fly toward their targets.

Ballistic rockets are quite fragile (one US accidental release of liquid rocket fuel occurred when a workman dropped a wrench onto the surface of a missile!). Thus, anything that can punch a tiny hole in the fuel tanks is capable of disabling a whole rocket and guaranteeing that the warheads get nowhere close to their targets.

Once the missile has boosted its payload into space, it is in another vulnerable position since it will be in a nearly airless area where many weapons can be used without the hindrance of atmosphere. When the warheads are released from the missile, they are unguided so that their ballistic arch can be precisely calculated. This would allow for a computer guided system to take on warheads coming back into the atmosphere on the third leg of their trip.

While the SDI system looks promising and should be pursued, again, it is hard to imagine that such a system would work with 100 percent accuracy. It is always possible that a nuclear explosion could occur even with an elaborate SDI system in place. Therefore, a good civil defense program would still be necessary to prevent a great loss of life.

Although not widely covered in the US press, the USSR is working on its own SDI-style system of defense and may, in fact, be ahead of the US in deploying it. In 1987, Mikhail Gorbachev said, "The Soviet Union is doing all that the US is doing... we are engaged in research which relates to those aspects covered by the SDI in the US". According to US Air Force General John Piotrowski (head of the US Space Command at the time of this writing), the Soviets have the capability of destroying US satellites up to 400 miles in space over the USSR. It is also believed that the Soviets will be placing a space-based laser system into orbit in the early 1990s. In fact, it would seem that the USSR is well on the way to getting an SDI-style system into place while US leaders argue about how much to spend on research on their own system.

Unfortunately, the US doesn't seem to be interested in developing a viable civil defense program designed at protecting its citizens from nuclear attack with or without an SDI system in place. This is not the case with the USSR. During the past 30 years, the Soviets have spent between 28 and 56 billion dollars on their civil defense program—and this does NOT include money spent on military facilities. (During the same period, the US Government has seen fit only to build a ring of shelters around Washington, DC for government officials.)

Will we ever be free of the possibility of a nuclear war?

Even IF SDI and other anti-ballistic missile systems, treaties, or disarmament should cause all the nuclear weapons in the world to be dismantled, the knowledge of HOW to make nuclear weapons would not vanish. Any nation with a nuclear industry would be able to build nuclear weapons in secret whenever they felt like it. No matter how rosy the future may look, the possibility of a nuclear war or terrorist action using nuclear weapons is only a few months away from the time all nuclear weapons are dismantled.

So even if the US should manage to get an operational SDI system in place, the American citizen will need to prepare to survive the "leaks" of weapons getting through the hi-tech shield on his own. And if SDI doesn't come into being (while the Soviets continue on their system), a "personal civil defense program" would seem to be an even greater asset to the average citizen since the probability of war would seem much greater if the Soviets have a system in place while the US does not.

Would cities ever be targeted for nuclear attack?

Cities currently make much better targets than do missile silos since military targets can be "hardened" to make them capable of surviving all but a direct attack and since they offer such a small target with little room for aiming errors. Cities are like the proverbial "side of a barn" in comparison. While one might argue that only a mad man would attack civilians, such was not the case in WWII when cities were attacked by both sides with little regard for citizens. Why would a modern war be any different?

Using cities as potential targets would also give an aggressor an effective way to blackmail a country into surrendering by threatening to destroy its cities; threats might even be backed up with an attack of a few just to prove the seriousness of the threat. (Interestingly, the US, because of its lack of civil defense work, is more vulnerable to such attack than the USSR.)

Such threats need not be made by the superpowers either; terrorists might also target large cities or power plants with small, carried-to-the-site nuclear devices.

What about a "nuclear winter?"

One of the scientists who did the original TTAP study has now admitted publicly that a nuclear winter would be more like a nuclear fall. Unfortunately, TV coverage for the original study was widespread while the coverage of the final facts all but invisible.

The original study was done using computer models which were quite crude; one of the original ones had the sun never setting but rather perpetually at high noon, 24 hours a day.

Apparently the scientists involved in the study were interested in proving that nuclear war would cause a nuclear winter: the worst case choices were always made in selecting data for the model and some data appears to have been grossly exaggerated by a factor of ten to make the "winter" occur.

A lot of strange assumptions were also made in the way vegetation and cities would burn in the original TTAPS study in order to "prove" a nuclear winter was possible. Unless there has been a long drought in wilderness areas and cities have no concrete structures in them, they aren't going to burn as violently as the models used by the TTAPS group. Too, the study assumes that cities would be attacked rather than just military and industrial targets; while this makes sense in some scenarios, it might not happen that way (especially if the cities were being saved as "hostages").

The TTAPS study also assumed that most military targets in the US were in forests or covered with heavy vegetation which would be highly flammable 6 months out of the year—which isn't the case. And according to the TTAPS model, burning vegetation would produce black soot (anyone who's watched a forest fire will dispute this assumption).

Even if the TTAPS conclusion were correct, there wouldn't be an ice age as many reporters seemed to think. Those connected to the study agree with this. There would be extremely cold weather; perhaps as cold as +5 degrees Fahrenheit to as low as -13 degrees Fahrenheit worldwide. Such cold would kill plants and many animals would die in areas not normally subjected to such low temperatures.

It must be remembered, however, that many areas of the world have had 3 months of extreme cold since day one of recorded history. The areas aren't devoid of life. (At least the northern US and Canada weren't last time anyone checked.) And past ice ages have not wiped the Earth clean of life despite much more protracted periods of cold.

Unfortunately politics have gotten mixed up with science in most nuclear winter studies. We'd all like to have a good way to prevent a war by being able to say, "Hey, look. If we have a nuclear war everyone loses." But saying it is so won't make it so. And all that is needed to start a war is for ONE side to think it isn't so. Faulty logic and science does little to convince anyone but perhaps the man-on-the-street; and he probably has no say over whether or not to actually initiate a nuclear war (especially in the USSR where mention of the nuclear winter theories have not even been made publicly). "Nuclear Winter" is a good example of how the public can be mislead by a bunch of scientific mumbo jumbo.

Here's what some well-known scientists have said about the TTAPS study that suggested the possibility of a nuclear winter:

"Frankly, I think it's an absolutely atrocious piece of physics," is what Princeton's Freeman Dyson said. MIT physicist Victor Weisskopf said, "The science is terrible." Harvard geophysicist Michael Elroy, "I think the TTAPS paper was absolutely atrocious... individuals who contributed to that...did so with a view that it was a political document rather than a scientific document."

Even assuming that the study's findings were correct, would this keep a country like the USSR from launching an attack? Would the Soviets be willing to turn the world into a huge Siberia for a few months if it meant that they would emerge as the final rulers? Would they be willing to face months of intense cold in order to wipe the "imperialists" off the map with a massive nuclear attack? Lenin said that even if it were necessary to kill three fourths of the world's population, it would be worth it if the remaining fourth became communist. You'll have to come to your own conclusion on this but it isn't hard to believe that such a risk might be taken.

A nuclear war might mean large-scale famine and starvation for many people in the world. IF the temperature took even a slight dip, those in tropical areas could see a large chunk of their native plants and animals killed. But mankind has survived ice ages stretching over decades rather than months. It seems unlikely that a "nuclear fall" would spell the end of the human race in and of itself (Carl Sagan's statements to the contrary.)

At the other extreme is the old idea that everything would be burnt to a cinder if a nuclear war ever started? And, of course, radiation would last for decades, etc., etc., as we've all seen in ON THE BEACH and other films embraced by the peace activists.

But, again, we're dealing with fiction. Tokyo, Hamburg, and Dresden were attacked in WWII by incendiary bombs. The resulting firestorms literally baked a number of the civilians who thought they were safe in their shelters. Many anti-nuclear people like to use these incidents as illustrations of how futile it is to try to survive a nuclear war. Why make a shelter if you'll only burn in it?

In fact there are major differences in the types of building materials used in the old cities attacked during WWII and the modern cities of today. The old cities were made of flammable materials and the buildings were very densely packed together. Modern structures use more concrete and brick and are built to avoid catching fire easily if a neighboring building burns. Too, actual tests of weapons show that nuclear blasts coming on the heels of the initial thermal pulse tend to put out any fires created by the earlier flash even with wooden structures. Secondary fires may indeed start from broken gas lines and spilled gasoline following a nuclear blast, but the fires will be little different from everyday fires.

Research done for fire fighters indicates that a certain amount of flammable material per square foot is needed to create a firestorm. The measurement of flammable material is known as the "fuel loading" of an area. To create a conflagration or firestorm like those of WWII, a fuel loading of at least 8 pounds per square foot is needed (and many authorities feel this is way too low to consistently start a conflagration).

Hamburg had a fuel loading of 32 pounds per square foot while modern urban neighborhoods—if densely packed—have a fuel loading of around 5 pounds per square foot. Most city areas with concrete buildings have even lower fuel loading while typical suburban areas have only 2 pounds per square foot. Thus, it would be almost impossible to create a fire storm in a modern city.

The only areas that will melt and burn to cinders are those within a mile or a mile and a half of the point at which a nuclear explosion occurs (ground zero). The nuclear explosion would create a thermal pulse wave which could—under "ideal" weather conditions—ignite small grass fires or char objects up to 10 miles away (for a VERY large bomb). But again, there is no wall of fire outside the area around ground zero and the earth is not going to be turned to a cinder.

If you've ever seen modern pictures of the areas where the first nuclear bombs were exploded in the US or the Japanese cities destroyed by American bombs in WWII, there is little sign of the damage that took place. Today the areas look no different than those around them; there are the same types of plants, same types of animals. Not even any craters to speak of since most of the weapons went off while in the air. Today Hiroshima and Nagasaki are thriving cities; while the rebuilding process would have been slower without outside help, the areas themselves weren't ruined by nuclear explosions.

But wouldn't radiation kill off most of the plants and animals following a nuclear war?

A 1975 study conducted by the National Academy of Sciences concluded that, though some species of radiation-sensitive plants and animals would suffer extensive damage and might even disappear from certain heavily contaminated areas, "It is reasonable to believe that after several years, animal populations would be reestablished except those of low mobility that are unable to recolonize previously occupied areas or those originally occupying mature forests that have not had time for complete recovery."

Damage to the ozone layer?

The same NAS study in 1975 addressed this issue as well. They concluded that, though 70 percent of the ozone layer which protects the earth from harmful ultraviolet rays might be destroyed by a major nuclear war, it would be regenerated within a few years' time and any climatic changes caused by its temporary destruction would soon change back to normal. Life would go on much as it was before.

But aren't there enough bombs to kill every man, woman, and child several times?

This is one of the common themes of peace activists. It's true—provided the populations of the world are all standing on each others shoulders and all confined to a few major metropolitan areas at the time of the attack. Since this isn't going to happen, anyone making such a statement either doesn't know anything about nuclear physics or else is lying through their teeth. Those making such statements are best ignored.

Here's why.

For the sake of argument, let's look at what a 20 megaton bomb could do in the way of destruction. A megaton (abbreviated "MT") explosion is equal to a million tons of TNT. A kiloton (KT) is equal to a thousand tons of TNT. In fact, the majority of the weapons stockpiled by the major powers are in the 1-2 MT range (with the trend toward smaller weapons) with few if any bombs as large as 10 MT. But let's use, for worst-case figuring, a weapon in the 20 MT range.

Here's how the FALSE reasoning goes: The bomb that destroyed Hiroshima was a 20 KT (Kiloton) bomb. It killed 30,000 people and its fireball had a radius of 0.08 miles. A 20 MT bomb is 1,000 times as powerful as the 20 KT Hiroshima bomb. (Right so far. But the next step kicks truth out the door.) Therefore, multiplying the radius of the Hiroshima bomb times 1,000 gives the area destroyed by a modern bomb; using this erroneous reasoning, a modern bomb would have a radius of 80 miles and—if you multiply the number of casualties in the Hiroshima bomb times 1,000—the potential to kill 30,000,000 people.

Obviously there's something wrong here or each country with a nuclear arsenal could stop with a few hundred bombs, quit collecting taxes, and still be able to saturate any enemy's country.

The fact is that when a bomb increases in size by a factor of ten, its destructiveness is only roughly doubled (that's partly because of the physics involved and partly because of how surfaces increase with circular areas).

NOW, if you take this into account, the 20 MT bomb is only 8 times as powerful as the Hiroshima explosion. A 20 MT bomb—if it existed—would have a fireball radius of only 0.64 miles (not 80 miles).

Other increases in the destructive potential of a large 20 MT bomb also multiply the same way. While the winds at the center of a 20 MT bomb would be up to 2,000 miles per hour, at 15 miles from the blast winds will have dropped to 55 to 115 miles per hour (depending on the height of the bomb when it was exploded).

And of course the number of people killed with such a weapon is pure conjecture. But surely a good civil defense program could reduce the casualties. Both Hiroshima and Nagasaki were unprepared for any sort of attack; had they been prepared, the number of people killed would have been much lower. (In fact, there were people who survived the Nagasaki explosion who happened to be in shelters within 1/3 of a mile from ground zero. As we'll see later, in a good shelter, a person can survive even a modern nuclear blast to within a few miles of ground zero!)

This is why most nuclear weapons are well below the 20 MT size; smaller weapons are nearly as effective as larger ones and easier to deliver and cheaper to build. It's also why there are so many nuclear weapons in the world's arsenals; they would be needed to wage a war.

Things are actually getting better, too. As missiles become more precise in delivering their warheads, the possibility of accurately "taking out" military targets becomes more viable and—at the same time—makes cities less ideal targets. Provided a weapons' development freeze isn't instituted, nuclear weapons might eventually be replaced with very small nuclear weapons or even conventional explosives mounted on super-accurate delivery systems.

Since the 1 to 2 MT range is the maximum you'd probably have to worry about in a nuclear exchange, let's look what a 1-Megaton or 2-Megaton warhead would do if it were exploded at the distance above the earth where it would create a MAXIMUM amount of destruction (if it were used against hardened targets, it wouldn't be dangerous for as great a range):

MAXIMUM BLAST EFFECTS OF A 1-MT AIR BURST

Miles from ground zero	Peak overpressure (psi)	Peak wind (mph)
0.6	140	2,500
1.5	24	600
3	8.8	250
6	3.2	100
10	1.4	50
14	0.9	34

MAXIMUM BLAST EFFECTS OF A 2-MT AIR BURST

Miles from ground zero	Peak overpressure (psi)	Peak wind (mph)
0.7	160	2,800
1.5	31	1,100
3	13.5	310
6	4.2	140
10	2.0	70
14	1.2	45
20	0.9	30

A little study of the above figures shows that if a person is 14 miles or more from the point at which a 1 or 2 MT weapon is exploded, and takes no action to protect himself, he'd be safe from everything but flying glass and—with the 2-MT bomb—would get a very light burning of the skin (similar to a sunburn). The only initial radiation he'd receive from the exposure at 14 miles would be less than 1 REM which would go unnoticed as far as having any health effects. As to the blast effects of the weapon, buildings of all types outside the 14 mile limit would not be damaged much—if at all—by a 45 mph peak wind.

A "rule of thumb" for your survival figuring is that areas within 10 miles of the bomb would be damaged—or destroyed as ground zero is neared—while areas outside that range will not receive much damage. Provided you've placed a little distance between yourself and a nuclear explosion, the blast and fire won't be too much of a danger.

What about the burns a nuclear weapon can produce?

Again, there's a lot of propaganda about how people will be receiving major burns for up to 25 miles from ground zero. Again, these are the figures for a 20 MT bomb exploded at the altitude that would create major damage. So a more realistic figure for receiving major burns is within 10 miles of ground zero.

But even with a 20 MT bomb, you would need not receive serious burns IF you knew how to take some evasive action. Since the thermal pulse wave that creates serious burns takes several seconds to build up with a 20 MT blast, diving behind a dense wall or into a ditch would enable you to avoid serious burns. If you got under cover within several seconds' time and stayed in such a place for at least 20 seconds, your chances of avoiding serious burns would be very good. Even IF you were being attacked by a 20 MT bomb.

As we've seen, with a 1 or 2 MT bomb, at 14 miles away, you'd receive only a "sunburn" (1st degree burn) even if you did nothing. Closer to the explosion, however, taking cover in a second or two would protect you from 70 to 50 percent of the thermal radiation as well as the blast winds coming after it. Quick action could prevent getting more than a slight burn and protect you from injury from flying debris.

(Those who have poked fun at the "duck and cover" teaching given to school children in the fifties are really quite criminal in their attitudes. By discouraging children from taking such actions, such comics have virtually guaranteed that many children who might escape serious injury during a nuclear blast will be severely burned.)

But doesn't a good civil defense program make a nuclear war more likely?

The reasoning behind this is that if a leader thinks his countrymen would survive a war—even though the economy would be wrecked, civilization would be down the tubes, and a lynch mob might try him as a war criminal later on—he might be more apt to start a war. Does this make sense? Such a mad man might be just as tempted to start a war because there were no viable civil defense plans made by the other side; after all, fewer enemy survivors mean fewer enemies to fight back. And fewer survivors would mean that there would be more supplies to go around for the winners.

Or maybe such a mad man would launch an attack because "the little people" told him to. It seems there is little logic here when one really stops to think about it. Logic—if it applies at all—suggests that a good civil defense program is more of a deterrent than anything else.

On the few occasions that I've actually pinned a nuclear freeze advocate on using such poor logic, his next move is to suggest that I go ahead and build a shelter; he'll just die when the time comes because no one would want to live after a nuclear war. Sounds heroic, but I'm afraid it won't be that easy.

So the next question: Is it possible to "just die" if a nuclear war occurs?

Let's assume that a guy who is going to "just die" stays above ground when the warheads come in. IF he happens to be in that small radius where the fireball incinerates everything, well and good. He will—more or less—JUST die. But even with worst-case figuring, that area is only around a mile wide at the very most.

Chances are, in fact, very good that he will die a rather horrible death after being cut to ribbons and/or cooked to rare steak proportions IF he's lucky. He'll be more apt to slowly smother under rubble or bleed to death from small, but serious, cuts. If he wishes to do that, that's his choice. But he won't "just die" unless he has a cyanide tablet and is still able to get it to his mouth.

And what about this such a person's family? It seems to me that this would-be heroic figure is actually a criminally negligent parent if he has children. If a nuclear war ever comes, surely those who have failed to give their families a way to survive the terror and pain of such a death would have to be among the most irresponsible beings to have walked the face of the earth.

Dying is seldom a simple thing in warfare. It often is very long and painful. Nuclear war is no different. Few would "just die" by choice.

What about radioactive fallout? Wouldn't it kill everything for years to come?

This is THE big bugaboo for many; fallout isn't as harmless as some might lead you to believe, but it isn't as dangerous for as long of time as a person might think.

As we've seen, fallout would be a real problem only if ground bursts were used in attacking an area. Ground bursts are ideal for hitting hardened military targets. But for attacking civilians, many military bases, or most industrial targets, air bursts create more initial damage and are therefore more ideal to use in combat where you want to quickly "take out" an opponent before he can take actions against you. With air bursts, some fallout will still be produced but not enough to worry about as far as short-term health standards are concerned. So a lot of nuclear weapons might be used without generating much radioactive fallout.

If the nuclear fireball does touch the earth, then super-heated particles of earth and molten matter pass through the fireball and become radioactive. These bits of matter then rain down as solid particles with the larger pieces falling close to the crater area and the smaller, ash-like particles falling over a greater distance. Some of the very smallest particles can remain airborne for long periods of time and may gradually be carried to all parts of the earth by high-altitude winds.

Of course the simplest way to avoid radioactive fallout problems is to move out of the area which might be attacked. For example, someone in Australia or some country far from a nuclear attack would only receive 10 more REMs of radiation than they normally would during the next 30 years following an all-out war between the superpowers. Since it takes at least 100 REMs of radiation during a few days' time to even make a person feel ill, such a person wouldn't even feel ill at all. (Sorry, ON THE BEACH was about as scientific as early FLASH GORDON comic strips.) But most would-be survivors won't be able to move to Australia. We need to look at other ways to avoid the problem.

OK. Assuming that fallout is produced because the fireball of a weapon actually touches the earth, most of the deadliest fallout particles will fall within the area of ground zero. Since no one will survive in that area anyway because of the flash and blast, that's not any great concern so long as you remember to stay out of such areas after the dust has cleared following an attack.

Other less radioactive fallout particles will drift down and be scattered downwind for hundreds of miles, however. But, at the same time, depending on how the wind blows, many areas would still not receive any large amounts of fallout since the wind will be blowing it away from them. So even if there is fallout, chances are good that you might still not have any problem with it.

In areas where massive fallout drifts, all would not be lost, either, because radioactive fallout is dangerous for a relatively short period of time. The initial radiation would decay to safe limits within a matter of weeks in many areas. Since fallout radiation can be stopped by shielding, a good shelter could protect those people who were in such areas.

Even if you were unfortunate enough to be in an area where EXTREMELY high amounts of radioactive fallout created 2,000 REMs per hour following an explosion, as we'll see later in this book, in ten days the level would sink to less than 3 REMs per hour and in a month's time the level would be only 0.8 REM per hour.

Thus, even in the very worst of circumstances, people would be able to leave a shelter for brief periods a few weeks after the last big nuclear ground burst happened in their area. And that's worst case figuring. Nuclear weapons involved with most fallout would probably be much smaller and the fallout much lower.

Certainly a prepared person who knew what to do would not envy the dead following a nuclear war (unless the person were suicidal in the first place).

How many would be killed in a nuclear war and how many would survive?

That's anyone's guess. But civil defense planners in the 1970's made the following estimates of the HIGH ranges of probable casualties for various attack scenarios:

NUCLEAR WAR U.S. FATALITY ESTIMATES

An attack on US ICBM's	8-10% of population
An attack on US Military targets	26-27% of population
An attack on US Military and economic targets	59-77% of population
All-out attack on all possible US targets	60-88% of population

Again, these are worst-case figures which assume that there is NO effort made by anyone in the US to create private shelters or take evasive action. Though a small percentage, many in the US would survive even if they didn't do a thing. In an all-out attack on cities and military targets, you would still stand a 1 in 10 chance of surviving IF YOU DID NOTHING. And, as we'll see later on, there are a number of ways to greatly improve your survival chances.

Will our government warn us when a nuclear attack is coming?

It might. But during computer mix-ups during the early 1980's when it looked like the US was actually under attack, NO information or alarm was passed along to the civil defense people. So don't make any plans for survival which hinge on getting a 10- or 20-minute warning from the authorities. (If you think you would still like to monitor for civil defense warnings, you can do so by purchasing one of the weather radios that monitors the National Weather Bureau broadcasts; new radios even have a special sensor which will turn the set on when a tone is sent out by the radio station.)

Will we know weeks ahead of time that a war is coming?

We might. And we might not. Certainly there were signs that war was coming before the last two world wars. On the other hand, if you take a sample of the news at any given point during peace time during the 20th Century, it is easy to see how a person might easily predict war when one wasn't about to occur; those who kept predicting it long enough were eventually right!

And if it was so obvious that war was coming, why did the outbreak of each war in Europe take so many by surprise?

For one thing, every time war is predicted and doesn't occur, everyone is lulled into ignoring the next warnings that war is eminent. Eventually, if everyone is alarmed often enough, the warnings are ignored. Only when you have the advantage of hindsight does it become evident precisely when war was coming. Only when you pick out the correct predictions of war, does it appear that some people knew it was coming. Many knew it was coming but assumed it would be later and hoped it wouldn't happen at all.

That's probably how a nuclear war would be, too. Lot's of predictions... nothing happens... more ignored predictions... and finally the doomsayers are right! But by the time a war actually comes, everyone has heard cries of "wolf" so many times that the warnings are ignored.

Too, attacks are often launched to take advantage of surprise. How many Americans were prepared for the attack on Pearl Harbor, even with the knowledge of the war raging in Europe? How many surprised military personnel were killed even though everyone was saying that war was on the way?

If a nuclear war begins with a surprise attack, it might be launched during a weekend or holiday. Or during the hectic times when a surprise attack could create major confusion such as rush hours, times when shifts are changed, or noon time. Such a "bolt-out-of-the-blue" surprise attack would pay large dividends to the attacker.

There are a number of other possible scenarios for nuclear war which are just as possible as the bolt-out-of-the-blue attack:

- A conventional war which escalates into a nuclear war. A small war might "spill over" into other areas and then blossom into a nuclear war. As more countries get nuclear weapons, the possibility will exist for limited nuclear wars between small countries like Israel and some of its neighbors or South Africa and those surrounding it. Treaties or vested interests might drag the superpowers into the conflict. Too, an attack by the Warsaw Pact countries on NATO forces which weren't prepared to fight a conventional war might leave no choice but to use tactical nuclear weapons to slow down the communist forces. If the choice were between losing Western Europe or using nuclear shells in a limited manner....

- A limited nuclear war might be started by mistake when a small number of weapons were launched by someone who was acting on his own or on false orders. The country on the receiving end might then retaliate with a limited number of weapons without further escalation of things.

- A limited nuclear war could also develop from a chemical or biological attack which couldn't be answered in kind. This, too, is especially true as things now stand between NATO and the Warsaw Pact nations.
- Accidental nuclear war might happen due to a miscalculation, erroneous information, or even a computer error. While this is unlikely, it is possible. Too, a terrorist attack with a few nuclear devices might be orchestrated to make a major power think it was under a nuclear attack from another large power.

Nuclear war would be a terrible nightmare. But the misinformation that many groups are putting out does nothing to avert war and may do a lot to lower people's chances of survival if a nuclear war takes place.

Unfortunately, while many in the free world are convinced that a nuclear war would be suicidal, the USSR seems to believe that a nuclear war is survivable and perhaps—according to the speeches made by some Soviet generals—even winnable. Our lack of preparation to survive such a war can only tempt such people to take advantage of their ability to weather a nuclear conflict.

Preparing to survive may actually be one small step toward preventing a nuclear war. Neither East or West is going to attack if they think there will be large numbers of angry survivors who will be seeking revenge on those who attacked them or survivors who will be willing to fight to keep their homeland. Americans prepared to survive a nuclear attack are a deterrent to Soviet attack.

Nuclear war can be survived and—once survived—those living need not worry about genetic damage or plagues of cancer or leukemia. Survivors need not envy the dead if the survivors have prepared to live on. Mankind and the earth would survive and civilization would undoubtedly rebuild itself just as it has following other great disasters.

With a little know-how, YOU can survive a nuclear war.

LIVING WITH THE BOMB

Perhaps the most frightening aspect of nuclear war is the radioactive dangers created by the weapons. Most of us have grown up fearing radiation. While a little fear of something dangerous is good, the mention of radiation causes some of the bravest of persons to turn pale and exhibit signs of panic. This isn't so good when it comes to surviving a nuclear war.

People need to remember that radiation is actually part of our everyday environment. Whenever a radiation meter is switched on in the world, it will register some radioactivity. Gamma rays coming from outer space, fertilizer, granite, and many other natural sources cause measurable amounts of radiation. In fact, the potassium in your blood stream contains minute amounts of radioactive potassium so that your blood is actually mildly radioactive and—surprise—some foods like baked beans and Brazil nuts contain minute traces of radium (you'd have to eat over 150 tons of either before you started facing any risk of danger!).

Regardless of the source, these rays penetrate our bodies day after day with each charged particle of radiation crashing through you being far from harmless; each one leaves a wake of destroyed cells and matter where it plows through your body. The good news is that living things are able to repair the damage faster than it is created. Thus, life on earth goes on despite the presence of radioactivity in the natural environment.

Which brings up the first point to consider: it's the amount of radiation you are exposed to which decides whether or not the radiation is dangerous.

The second point is that the less exposure you get to radiation the better for your long-term health. Whether you're in a nuclear war or getting X-rays at the doctor's office, minimizing any exposure you have to take will allow your body to have a better chance to repair the damage done to it and will reduce long-term risks of cancer and other radiation-related diseases.

There are many types of radiation: radio waves, light, X-rays, microwaves, ultraviolet, infrared, etc. The most dangerous radiation is ionizing radiation; it strips parts of atoms apart—creating unstable charged bit of matter called "ions"—and can do a lot of damage to living things and sometimes cause genetic damage to cells so they can't replicate properly. Anything giving off ionizing radiation is known as being "radioactive."

Four types of ionizing radiation are created by nuclear weapons: Alpha particles, Beta particles, gamma rays, and neutrons. Of these four, Alpha and Beta particles are the least dangerous. These two types of radiation have very low power levels so they can be stopped by thin layers of material. Neutrons and gamma rays produced by a nuclear weapon are much more dangerous; these particles penetrate lightweight materials very easily so that only thick layers of dense material will protect a person from gamma or neutron radiation.

Many of the normally stable elements are changed into isotopes by nuclear weapons. Isotopes act like their normal counterparts except for the fact that they have more sub-atomic parts to them so that they are radioactive. As these extra parts of each atom are given up in the form of radiation, the isotope turns into a more stable form. Many of these forms are no longer radioactive and therefore less dangerous; the time taken for a radioactive isotope to turn to a non-radioactive form is known as its "half-life."

The amount of energy which is given off by a radioactive substance is measured in Roentgens here in the US; another measurement often used is the REM (Roentgen Equivalent in Man).

A unit of measurement that is sometimes used in the medical and nuclear industry is the "Sievert" which is abbreviated as "Sv." The Sievert is a large unit so it is generally given as milli-sieverts (or thousandths of sieverts). One milli-Sv is roughly equal to 100 milli-REMs.

In Europe and elsewhere, the new standard is the Gray; unfortunately this standard increment was also made rather large so that normally CentiGrays (abbreviated "cGy") must be used. A CentiGray is equal to one Roentgen.

For practical purposes when dealing with human beings and the massive doses of radiation to be expected during a nuclear war, the CentiGray, Roentgen, and REM are all nearly the same and can be used interchangeably with 0.01 Sievert being a rough equivalent as well. All a "quick and dirty" survivor in a post-war, radioactive environment needs to know is that CentiGray, Roentgen, and REM are units of energy that are equivalent in computations and readings.

It is important to remember if you're taking a reading of radiation on any type of detection device that readings are given either as a total reading in REMs or Roentgens OR as the total amount that would be received per hour if the level of radiation remained steady for that period of time. Total dosage and dosage per hour could be quite different.

For example, a reading of 60 REMs per hour could mean a total exposure of only 1 REM if you were in the area for 1 minute. That would hardly be worth worrying about (by nuclear war standards, anyway). On the other hand, if you were to stay in the area giving a 60 REMs-per-hour reading for 10 hours, the total exposure would be 600 REMs which would make you very sick and would probably prove fatal if you didn't get proper medical help.

Bringing us to the next question: How much radiation exposure is safe? The following chart should give you some idea of what you can stand in the way of radiation during a short period of time. It should be noted that doses below 100 REM will not produce any noticeable symptoms. At the other end of the scale are doses above 1,000 REM; if received in a short period of time, these will always be lethal within 1 hour to 14 days. Onset of symptoms with such a massive dosage will occur within 30 minutes and will probably include some or all of the following: diarrhea, fever, convulsion, tremor, ataxia, and lethargy. Death will occur from a circulatory collapse if only around 1,000 REM have been received while respiratory failure and brain edema occur with very high exposures.

RADIATION DOSES AND EFFECTS

DOSE:	100-200 REM	200-600 REM	600-1000 REM
VOMITING:	5-50%	50-100%	100%
DELAY TIME:	3 Hours	2 Hours	1 Hour
1ST SIGN:	————Hematopoietic Tissue————		
SYMPTOMS:	Moderate leukopenia	Severe leukopenia; purpura; hemorrhage; infection. Epilation above 300 REMs	
CRITICAL PERIOD:	————	4-5 Weeks	6 Weeks
THERAPY:	Reassurance; hematologic surveillance	Blood Transfusion; antibiotics	Bone marrow transplant
PROGNOSIS:	Excellent	Good	Guarded
CONVALESCENCE:	Several weeks	1-12 Months	Very long
DEATH:	None	0-80%	80-100%
CAUSE OF DEATH:	———	—Hemorrhage and/or infection—	

Studying this chart for a few minutes will show you that 200 REMs is about the top limit you can receive in a short period of time without having ill effects (with under 100 REMs less apt to make you sick). It is important to remember that this chart is for total exposure occurring in a SHORT period of time. If these exposure limits occur over a longer period of time—months or years—your body has more time to repair itself and you can take a much larger total dosage without the ill effects shown on the chart.

While survival is possible with doses of radiation higher than 200 REMs, some very specialized medical treatment is needed. Since marrow transplants or even blood transfusions wouldn't be an option for most of us during a nuclear war, "survivable" doses in peacetime would probably prove fatal for many during a war.

Some people have a higher tolerance to radiation than is shown on the chart; and some have a lower tolerance. In general, youngsters, the elderly, or those with poor health will have lower tolerances. But play it safe and try to minimize your exposure whenever possible.

The chart also shows total body exposures. If it is possible to protect some parts of the body from the high levels of exposure, a person's chances for survival might can be improved. For example, if you were able to give extra shielding to your legs (and thereby protect the large bones in your legs which produce blood cells) so that area of your body received a smaller dosage of radiation than the rest of your body, you might survive higher exposures of radiation. This is because the marrow in the large bones would continue to produce blood cells for your body even though the other bones were "knocked out of commission" by high levels of radiation. While shielding some parts of the body is not generally too practical, it is something to keep in mind.

Provided you survive, many of the symptoms created by "radiation sickness" are only temporary. For example, if you've been exposed to a high level of radiation, you may lose some hair but—if you weren't already bald—the hair should regenerate itself later on. Likewise, although sterility is induced in men and women (especially with exposures of 450 REMs or more) it will be only temporary.

Radiation "sickness" is not contagious. Those who are sick should be checked and cleaned so that they don't spread any fallout dust that may be on them but otherwise they can't "contaminate" others. They may, however, have diseases which are contagious because their immune system will be weakened by exposure to radiation (as will those of others exposed to radiation). Therefore, some precautions are in order when dealing with people who are ill from excessive exposures to radiation.

Now, let's look at the sequence of events creating the destruction of a nuclear explosion and its radiation.

A nuclear bomb is detonated when the radioactive material in it is super compressed by a chemical explosive. When the explosion compresses the radioactive core, the material creates a chain reaction of splitting atoms during which matter changes into energy. This chain reaction of events continues very quickly until a great burst of energy results. This splitting of atoms into lighter elements to release energy is known as "fission."

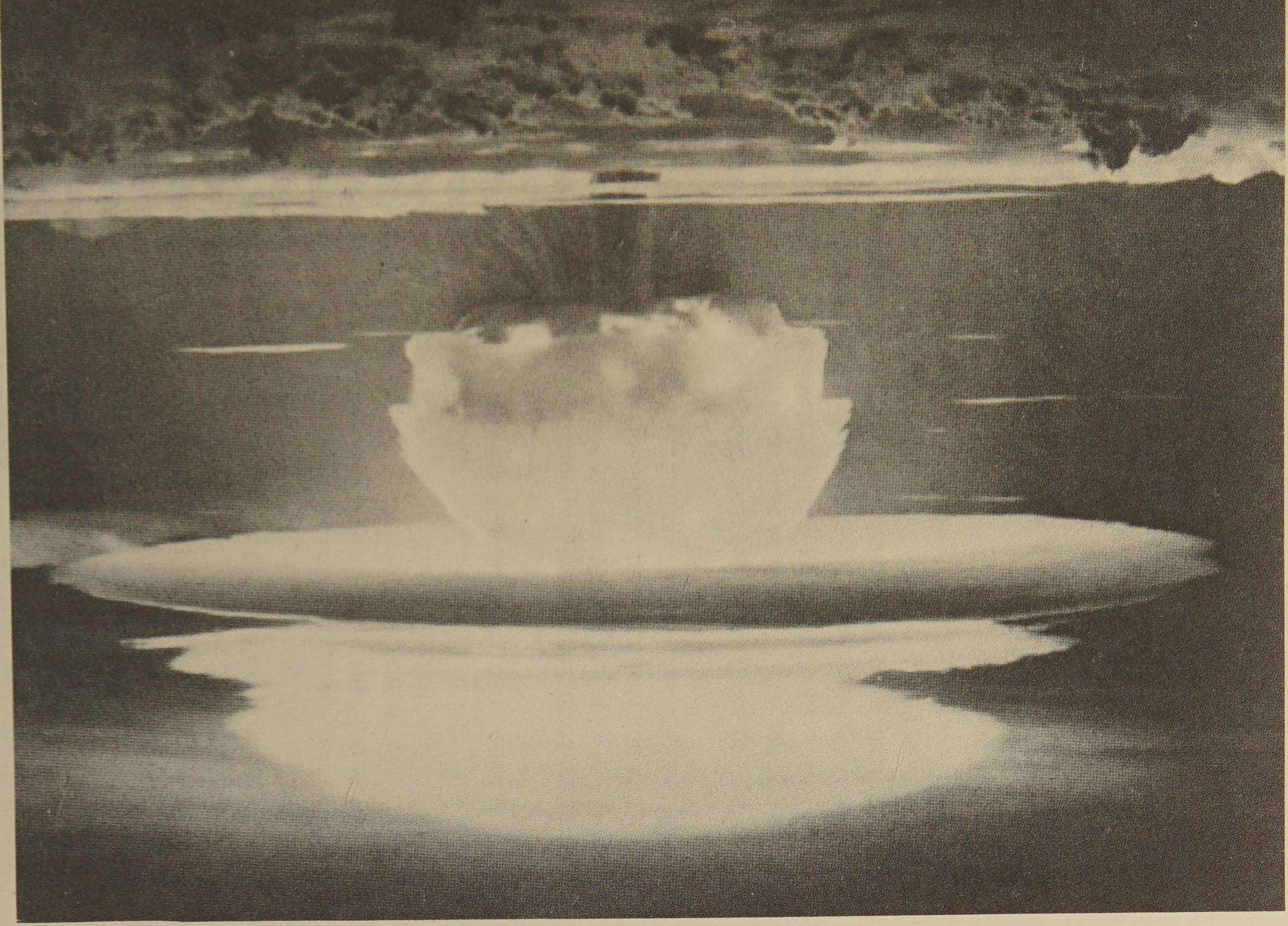
It is also possible to use a nuclear fission explosion to create a very high temperature so that elements are fused together. This also releases vast amounts of energy and is used in hydrogen bombs. This process of fusing atoms to release energy is known as "fusion."

(The intense heat of the explosion causes fusion bombs or warheads to be called "thermonuclear" weapons. Throughout this book, we'll discuss weapons as being "nuclear" since there is no way to predict whether the weapon used in any given area will be a fission or fusion weapon.)

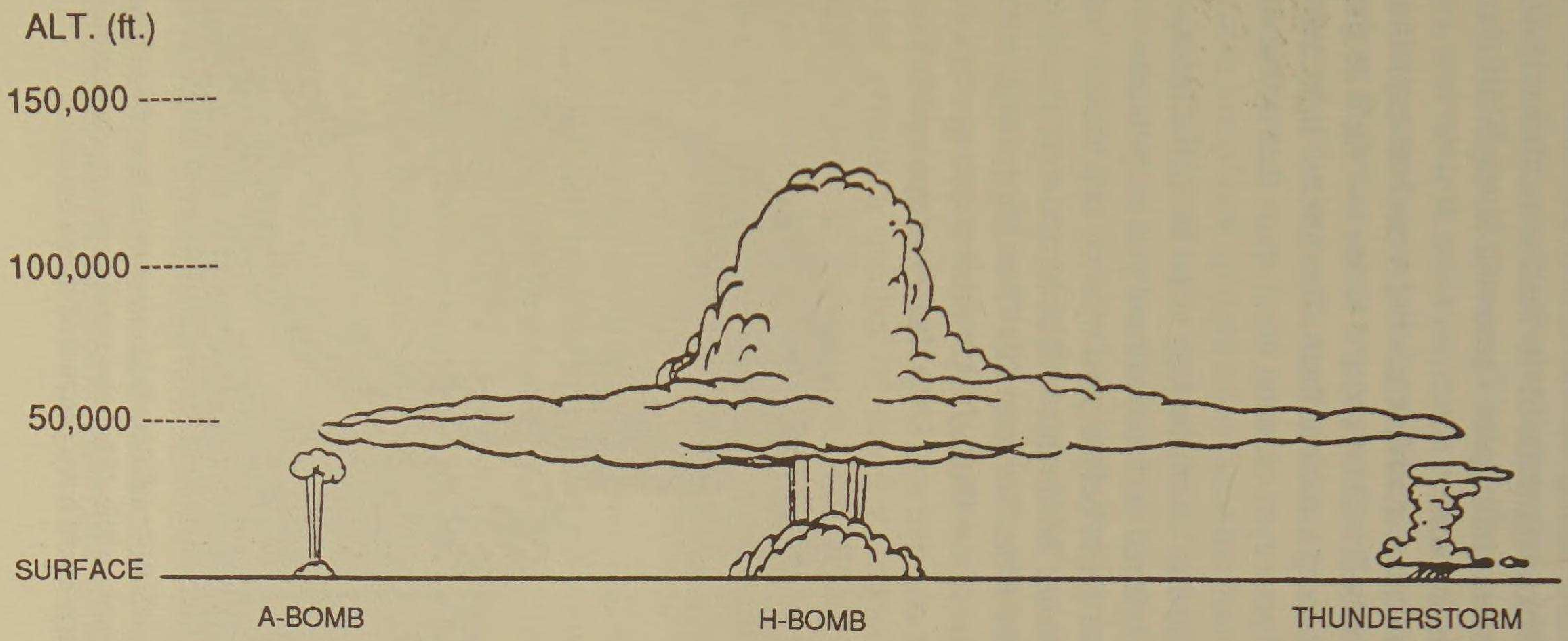
Regardless of the type of nuclear explosion, the energy released will be in a number of forms. These include visible light (at its peak, four times as bright as the sun), thermal (heat) rays, and ionizing radiation in the form of gamma rays, neutrons, Alpha particles, and Beta particles.

The release of energy during a nuclear explosion super-heats the air around it until it is hotter than the face of the sun. This super-heated air expands violently and creates a blast wave that races away from ground zero (the center of the explosion) at speeds of up to 4,000 miles per hour. Fortunately these wind speeds soon drop off as the distance increases. The air ahead of this wave becomes so compressed that it bends light and appears slightly luminous. As this compressed wave travels, it appears as if a sheet of glass is moving out along the edge of the blast. The blast wave sounds—as an unknown observer once described it—"like the gates of Hell clanging shut" and can cause extensive damage.

While the blast wave is storming out from ground zero, the fireball of the heated air is rising upward and creating a vacuum under it in the process. This vacuum pulls air back toward ground zero so that the air pushed out by the blast wave is sucked back toward the area of



(Above) A thermonuclear ground burst showing the fireball as it travels upward. Rings are blast waves moving out from the blast. As the fireball travels higher, dust and other molten material is sucked up from the ground to form fallout which will drop from the air as it cools off.


ALT. (ft.)
150,000 -------
100,000 -------
50,000 -------
SURFACE
A-BOMB
H-BOMB
THUNDERSTORM

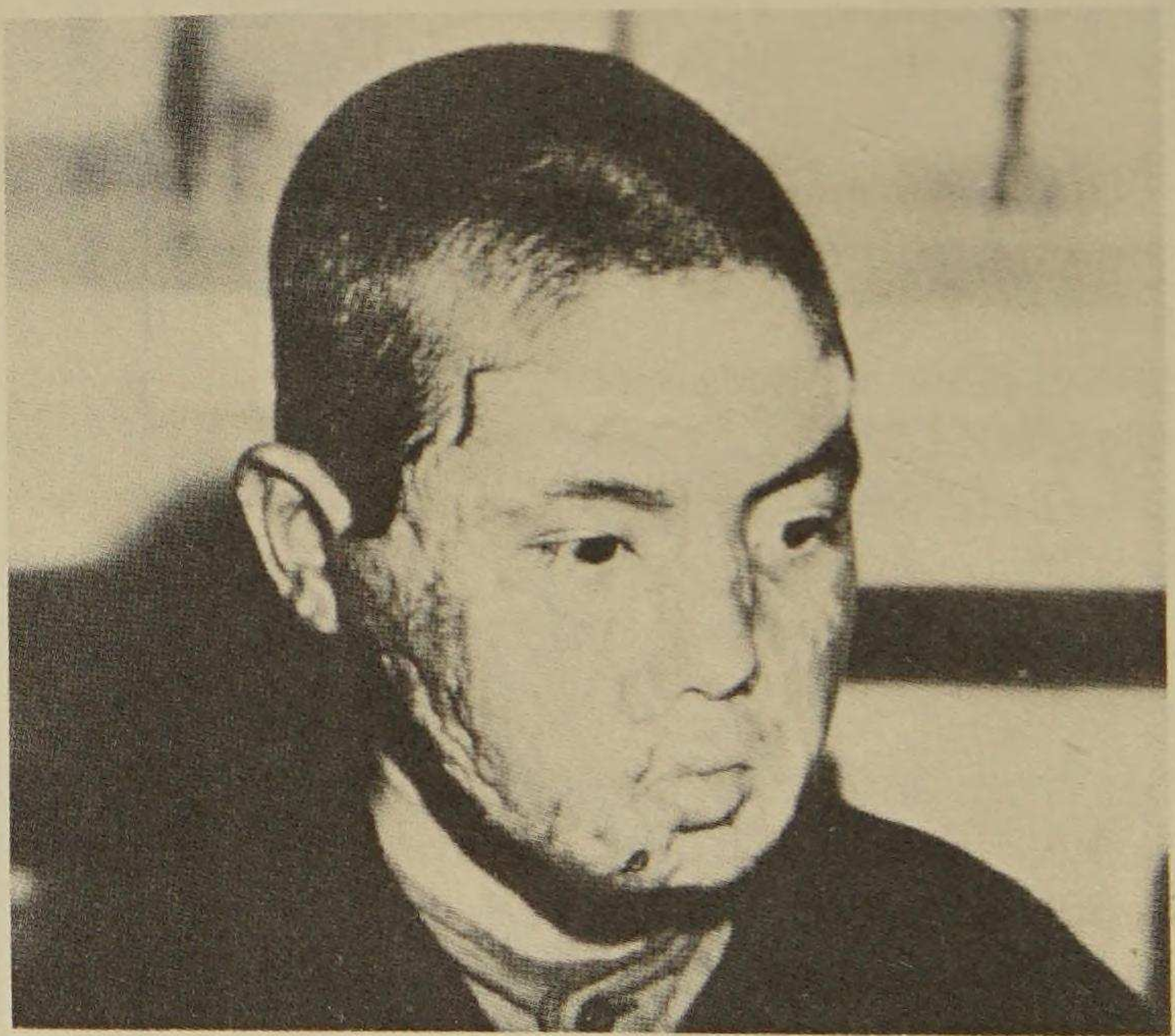
Realative sizes of a fission bomb (left), a fusion bomb (center), and a thunder head cloud.

the explosion. Thus, there are two distinct parts to the blast wave: a pressure wave racing outward from the blast and a suction wave traveling back toward the blast. Both are extremely destructive.

Now let's bring things to a personal level. What should you do if a nuclear blast occurs?

You won't have trouble knowing a nuclear explosion has occurred since the fireball will be about 4 times as bright as the sun. Do NOT ever look toward a nuclear flash. The intense light can burn spots into the back of your eyes creating blind spots that will last the rest of your life.

Even if you don't look directly at the flash, the intense light reflected from light-colored surfaces around you may dazzle your eyes so that you may see spots before your eyes or experience "snow blindness" for a short time. While this will be temporary, you may not be able to see much for a bit. To keep this from happening, cover your eyes at the first sign of the flash. If you must see to get to a safer spot, close and protect one eye and keep the other eye open. You may sacrifice



The initial pulse of radiation (also known as the "flash") can cause severe burns as shown on this Japanese survivor of a nuclear attack. The "duck and cover" strategy could have prevented these injuries.

the vision in one eye for a while but will still have it in the other.

You won't have much time to look for safety but you will have a few seconds. Of the whole spectrum of radiation given off by nuclear explosion, the visible light is given off before the more dangerous thermal, gamma, and neutron radiation reach peak levels. Because of this, you have a short grace period during which you can duck behind something heavy or even just cover any exposed skin and get against the ground. Doing so will allow you to minimize any skin burns you might otherwise receive.

You don't want to jump back up right away since the blast wave may be storming toward you. If you're dangerously close to the blast, you'll only have 2 to 15 seconds to take cover. If the blast wave is going to be dangerous, it should have passed through your area after two minutes. Of course, if there are multiple explosions, you will have to give each one two minutes. After this "two-minute warning" time for the blast to pass, you get up and head for permanent cover from the fallout (more about this in a moment).

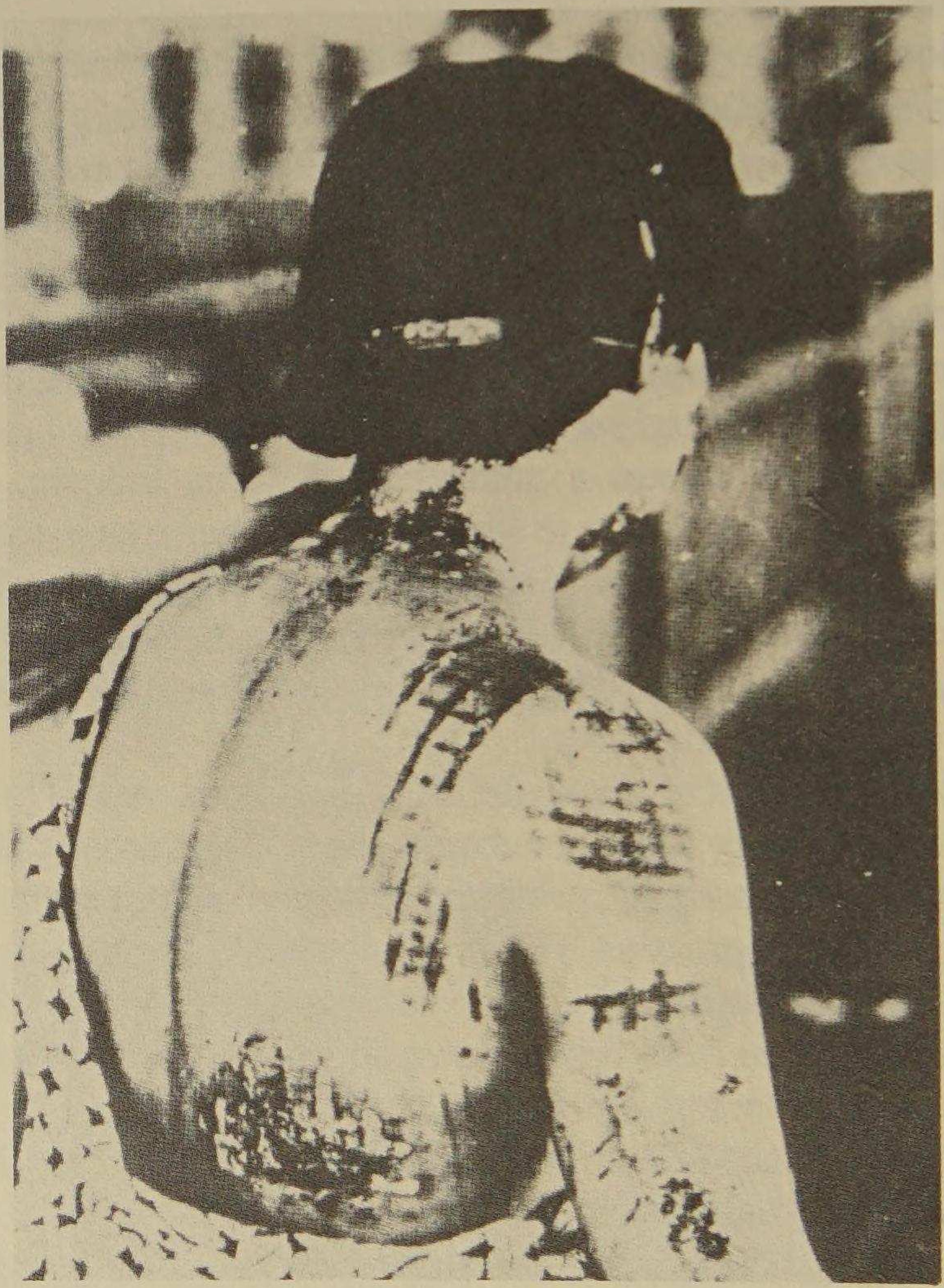
The blast wave creates a number of dangers. Indoors, glass is probably the worst. Closer to ground zero, other flying debris like plaster or chunks of wood become very dangerous as well. Once you've dived for cover from the thermal radiation, try to crawl quickly to a room that doesn't have any windows and stay down until the two minute waiting period is over.

Outdoors, all types of blown debris is dangerous. And if you don't stay down, you may actually become one of the pieces of debris. If you can't get into a strong, protected structure, at least try to get into a ditch or other depression. If this is impossible, then try to at least cover your head and try to lie with your feet pointed toward the blast. This may keep you from being blown about and your shoes and feet can withstand more abuse than your head.

If a war appears to be a very possible thing in the near future, there are a number of things you can do to minimize the damage to your house from the thermal pulse and blast effects of a nearby explosion.

One thing that can be done well in advance is to have a light-colored roof and house paint, especially on wood frame houses. This will make your home more fire resistant to the thermal pulse of a nuclear weapon (the worst surface to have on a house is weathered wood which offers little resistance to thermal radiation). Brick or stone facings on a house are very resistant to thermal damage.

Some trees, shrubs, and grass are more fire resistant than others. Grass shouldn't turn brown in the fall (Bermuda is bad from this standpoint). Many evergreens also tend to be more flammable than deciduous trees and might well be avoided in areas where a thermal pulse may be dangerous.



A graphic example of how clothing color can influence the heat build up from a nuclear flash. The initial pulse of radiation caused severe burns where the dark portions of a Kimono touched this Japanese survivor's skin. Again, the "duck and cover" strategy could have prevented these injuries.

Blast damage can turn window glass into jagged daggers. To keep chunks of glass in the window, place an "X" of tape across each pane of glass (use Scotch tape if you're worried about how it looks but cloth tape is a better bet since it's stronger). Clear contact "paper" (it's actually plastic) can also be used for this purpose.

White drapes, curtains, or shades will reflect thermal rays back out windows and keep the rays from burning things inside the house. Dark curtains could well catch on fire and should be removed from windows.

If you are at home before fallout arrives or war seems very eminent, it would be wise to get rid of things around your home that might burn. Bushes, dead grass, firewood stacked next to the house, garbage or papers in the house, etc., should all be moved. If your area may have freezing weather while you're holed up in your shelter, it would also be a good idea to drain the water out of your home's pipes to keep them from rupturing and damaging the inside of your house.

After the blast wave has passed, seal up the windows and doors with duct tape to minimize the fallout dust entering it and cover any windows which are cracked or have been blown out with plywood or plastic sheeting.

And where does fallout come from?

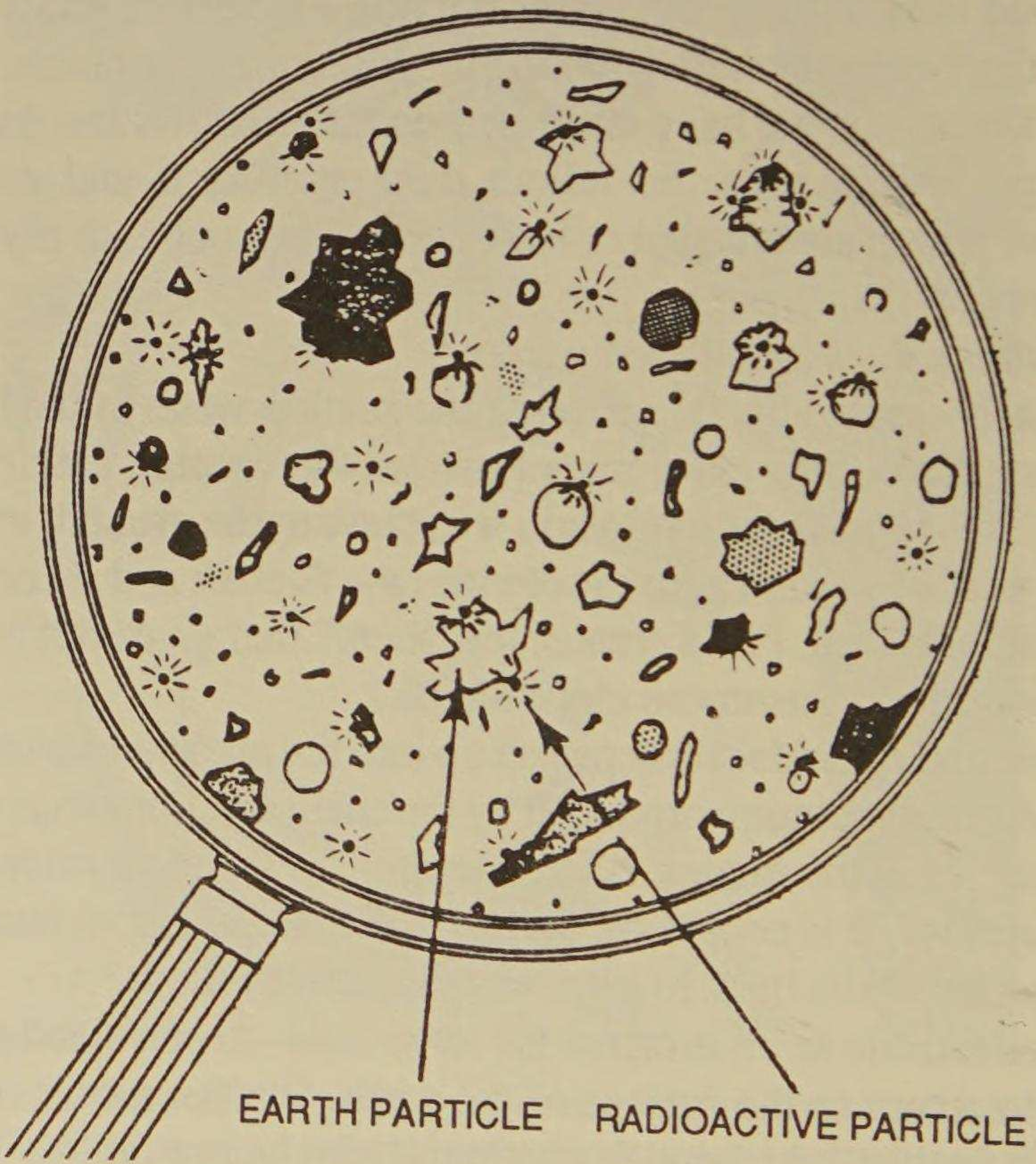
Fallout is created by the action of the suction wave of the blast. As the winds blow, they carry matter toward the vacuum created by the fireball as it rises. If the explosion was close to the ground, the matter sucked toward ground zero moves into the fireball and is incinerated by the intense heat. (This creates the "stem" that gives many nuclear explosions their mushroom cloud shape.)

As dust and other debris is pulled up into the nuclear explosion, it is exposed to the radiation produced by the chain reaction which induces radioactivity in the matter. As this molten, radioactive material continues upward, it is cooled off and solidifies in the upper atmosphere and gradually falls back to earth as radioactive fallout.

It takes as little as 15 minutes for large sand- to pea-sized pieces of fallout to return to the surface of the earth. Smaller pieces of fallout will drift farther downwind from ground zero before falling. The very smallest of particles may be light enough to continue to be airborne for days, weeks, months, or even years and can be blown quite a distance by high-altitude winds. Because of the time needed before fallout can reach the ground, areas down range which will eventually receive dangerous levels of fallout will remain free of radioactive particles for up to several hours following a nuclear blast. (This will give those who know what they're doing time to move to a shelter or other safe area.)

The very small particles of fallout may also be brought back to earth by rain or snow which forms around the tiny bits of radioactive dust. In such a case, the precipitation would create a perceptible rise in the radioactivity of the area into which it fell.

Fallout particles can take a variety of forms and color depending on the material that was at ground zero. White, gray, or even black ash or "popcorn" like particles of expanded materials might be en-



Fallout particles can have a variety of shapes and colors, depending on the material that was present at the site of ground zero.

countered. Whatever its form, however, it will be falling from the air and will not be something normally encountered.

So, once you've survived the blast, chances are good that it will be at least 15 minutes—and probably hours—before fallout becomes a problem for you. If the blast nearest you didn't create any fallout, it might even be a day or more before fallout reaches you. That means you'll have some time to either return home to your shelter or to find a make-do shelter (we'll look at what's needed for shelter later on).

If you are trapped in the open when fallout starts to arrive, you must get out of it as soon as possible. Keep the fallout off your skin by brushing it off your clothing and try to cover your head; use a wet handkerchief over your face to keep from inhaling the dust. Any time spent in the fallout will greatly lower your chances for surviving.

When you're heading for—or trying to find—shelter from fallout, it's important that you don't get side tracked since you don't know how much time you really have. Communications will be disrupted, many areas destroyed, and many people will panic. People who fail to get into an area sheltered from fallout will soon be dead once it starts to arrive in areas receiving heavy contamination. Therefore, if you can help someone get to shelter, well and good. But you'll have to be rather hard-hearted at this point and not lose time trying to help those who will die without medical help or who refuse to take shelter.

During such a time, you'll also need to be careful you don't get sucked into unwise decisions or suggestions from others who don't have any real idea of what a nuclear blast's effects will be. Warn people of what is coming and then take care of yourself. You have no duty to die just because others refuse to protect themselves.

Don't try to take shelter somewhere that will gradually become packed with people. A lot of "public fallout shelters" are only signs. Currently, shelters in the US are not stocked with food, water, or anything other than dust. Many do not have adequate ventilation for the capacity of people they're rated for, as well, and no efforts have been made recently to change the capacity numbers despite the fact that civil defense authorities know about this problem. Such "shelters" could attract too many people while offering little protection; lack of ventilation, supplies, or sanitation facilities will turn these places into death traps.

(If you're away from home a lot, a small "bug-out" bag of essentials you might need would greatly improve your chances of surviving a nuclear war; such a bag in a closet or locker at your place of work or in the trunk of your car could be a lifesaver.)

How will the fallout be distributed over the area you're in?

When all but the smallest of fallout particles (which will remain airborne for a long time) have fallen back to earth, a strip of ground up to several hundred miles long and 30 or 40 miles wide will be contaminated by fallout. The highest concentrations of fallout will be near ground zero; concentrations will become lighter as the distance from ground zero increases.

There's no way to predict the size or shape of a fallout pattern. The high altitude winds involved are ever changing; these winds determine the pattern. Since the high-altitude winds shift from day to day, depending on the day of the attack, most areas could be totally safe on one day or could receive a massive dosage another day.

While many charts and graphs are available which try to estimate the amount of fallout and its decay rates, these probably won't be too practical in the "real world" following a nuclear war. This is because it's possible that there will be multiple attacks and many explosions will undoubtedly overlap in their fallout patterns. Unless a person is planning on having a working computer in his fallout shelter with observers phoning in information about where explosions occurred, it would seem doubtful that very accurate calculations of how quickly the fallout in an area will be arriving and decaying.

Too, to further complicate things, fallout tends to blow and drift like snow. Even if a person had the overall levels of fallout figured out along with their decay rates, there would still be dangerous hot spots created by drifting fallout which will defy the logic of calculations.

Fortunately such estimates aren't absolutely necessary. The idea is to get minimum exposure to radiation. One plus for those planning to survive a nuclear war is the fact that radioactive fallout produced by a nuclear weapon loses its energy very quickly. This quick loss makes it very dangerous at first since radiation levels are high, but also means that it won't be dangerous for more than a relatively short time. Those who can find a safe place to "hole up" during the period when the fallout is very dangerous can survive to travel in the "great outdoors" again in a short time when radiation has sunk to safe levels.

There are a few long-range considerations when dealing with fallout, however. While most of the radioactive isotopes created in the reaction of a nuclear bomb are very short lived, some are more stable AND tend to be deposited in certain organs of the body. Thus, while the total dosage of the radioactive particles may be small when compared to total body mass, they may create a lot of localized damage because they are concentrated in small areas in the body. This can become a serious problem if the organs involved retain the materials for a long time.

Probably one of the most hazardous to those exposed to radioactive fallout is the isotope Iodine-131. While other isotopes of Iodine (-132, -133, -134, etc.) all have half-lives of less than a day, Iodine-131 has a half-life of about 8 days. This material is stored by the body in the thyroid gland and the gland can be damaged in short order by it.

Fortunately, the body can tolerate large levels of iodine for short period of time. This allows a person to increase his intake of iodine and reduce the chances of his body storing the radioactive isotope of iodine and/or help his body to shed the isotope if it has been taken in.

One way to get the massive dose of iodine needed to counter the exposure to radioactive iodine is to take doses of Lugol's Solution. (This solution is also known as potassium iodide saturated solution, SSKI. It can be purchased in most drug stores and will keep for some time if it's stored in a dark brown glass bottle with a non-metallic lid. Even longer storage life of the chemical is possible if purchased as potassium iodide crystals. These may be purchased through your local drug store, too.)

The solution should be mixed by filling a container 60% full of the crystals and then adding water so that the container is filled to 90% of its volume. When the crystals dissolve (with a few crystals remaining undissolved on the bottom), it is ready to be used. The amount of the solution to be taken is 130 milligrams per day (about 4 drops if you have no way to measure it) for adults with children under one year old getting about 1/2 of this amount—65 milligrams (about 2 drops). The medication is to be taken from the first day of the first nuclear explosion and the dosage continued for 100 days after the last explosion in your area; the dosage can be safely taken by most people each day for a year.

Lugol's solution is not without its shortcoming, however, because the solution tastes terrible, it has to be taken with a lot of water and food. Side effects include the possible development of a goiter.

More expensive, but easier to take, are potassium iodide tablets. Currently, these are available under the brand name of "Iosat" and come in "prepacks" of 70 tablets with each tablet having 130 mg of potassium iodide in each. (This is an adult dosage; children would take one half tablet per day.) These are available from Phoenix Systems, Inc., for $23 per prepack.

New research shows that it's possible for the skin to absorb iodine. While the final tests haven't been completed, it APPEARS that painting a patch of skin (about the size of the hand of the person being painted) with 2% tincture of iodine would give the body the extra iodine needed to avoid the adverse effects of Iodine-131. While the final results of testing being done aren't in, this would beat doing nothing so you might consider this if you don't have the Lugol's Solution on hand.

Plutonium-239 is another dangerous isotope to be found in fallout. It can be absorbed through particles inhaled into the lungs. These particles become trapped in the lungs to cause tumors years later or—if absorbed into the blood stream through the lungs—may be deposited in the bones and liver. Because of the long half-life of plutonium (24,000 years) and the tendency of the body to store it for many decades, it's quite dangerous. The only way to avoid inhaling it is to filter the air coming into your shelter and to wear a mask with dust filters when you're outside the shelter.

Two other isotopes produced by nuclear explosions tend to be absorbed by the human body. One is Cesium-137; it spreads throughout the body, however, and is usually retained only a short time and therefore poses little problem to human beings in levels that might occur following a nuclear war. (Cesium mimics potassium in the human body; taking a potassium supplement would help reduce the intake of Cesium.)

The other isotope, Strontium-90, is more of a problem because it has a long half-life and is chemically similar to calcium which the body stores for long periods of time in bones and other tissue. Fortunately, both plants and animals will "choose" calcium over Strontium if sufficient amounts of calcium are present.

Since Strontium-90 is deposited on the surface of the ground as fallout, it's also possible to carefully remove it from areas where food crops will be planted. Thus, by increasing calcium intake to plants or animals and by removing contaminated top soil, the levels of Strontium-90 exposure can be greatly reduced.

You can also reduce your Strontium intake by not eating plants which have received fallout on them and by not eating parts of animals which absorb Strontium-90 (more on all these "how-to's" later). With a few precautions you can avoid ingesting dangerous levels of this isotope.

A wide range of other isotopes are created in a nuclear explosion but these either have short half-lives or are not retained by the body to any great degree so that it is unnecessary to worry about them.

Of course you won't just leave your shelter and go back to "business as usual" once the fallout has sunk to safe levels. Some thought needs to be given as to how things might be if you're to survive past your shelter stay.

Post-war society certainly would be much different. While most people cooperate following a disaster, studies show that the post-disaster euphoria that is usually experienced by survivors of a disaster was NOT experienced by the people who survived the Nagasaki and Hiroshima blasts. In fact the people in the two populations didn't even cooperate to carry out their own rescue work as is normally the case in disasters.

According to the social scientists who study such things, the reason for the lack of help is that the more sudden and unexpected a disaster and the greater its devastation, the less apt people involved in the disaster are to help each other. A nuclear war could certainly be about as unexpected and widespread as possible. So you must plan on getting by on your own during and after a nuclear war; the idea that "we'll all just pitch in together and work things out" is not realistic when thinking of nuclear war.

The two attacks on Japanese cities also created rather bizarre behavior among many people. Often, those who had moderate mental problems during normal times came apart at the seams with the sudden destruction from the nuclear bombs. There are numerous stories of people continuing at their jobs as if nothing had happened or trying to go to work in areas totally destroyed by the blasts.

You may experience such pressures before and during the first critical hours of a nuclear war; resist pressure from those who don't—or won't—grasp what is happening and ignore advice to "stay on the job" or that "everything is going to be all right." Following such advice could cost you your life.

Survivors of any major crisis sometimes feel guilty for not dying when many others have perished. This is normal but remind yourself that you have no real reason to feel guilty. You won't be responsible for starting the war and you certainly won't have kept anyone from making the same preparations you made to survive.

Most research of the WWII nuclear attacks also suggests that feelings of extreme stress or depression will also be common following a nuclear war.

Stress isn't necessarily bad. It can press you to work harder and to be tougher IF you'll channel it toward such results. To help control stress, try to maintain control of whatever you can, even if it is just through the creation of a routine and keeping the small space of your shelter spick-and-span. At the same time don't worry about things that are out of your control.

Problems will be plentiful following a nuclear war. While it may seem selfish now, the only way a person can handle things when facing a large-scale disaster is to deal with his own troubles and ignore all other problems. Don't dwell on the nation-wide situation or even the general area you're in if disaster is wide spread; doing so can sink you in a sea of depression. Do what you can to rebuild things and ignore problems you can't do anything about. This will help keep problems from overwhelming you.

With preparation and mental discipline, you CAN survive a nuclear war and its aftermath.

RADIATION AND EMP

To understand what you need to do to protect yourself from radioactive fallout and the blast effects of a nuclear bomb, it would be good to look at a little—and very simplified—"survival physics." The basic concepts needed for protecting yourself from fallout and other types of radiation are quite simple, once you recognize a few basic facts and rules.

Nuclear radiation starts out being rather mysterious to human beings since we can't see or sense it (except in extremely large amounts when it creates a tingling sensation). Yet we all deal daily with things that are beyond our senses such as radio waves and microwaves; these are, in fact, actually in the "radiation ball park." So the concept of invisible energy isn't quite as foreign to our thinking as one might first imagine.

For starters, we're going to skip the splitting of atoms and such stuff (check a physics books if you're interested in the "how's"). Instead, we'll just touch on the facts you need to know to survive.

Nuclear weapons come in assorted sizes. As mentioned before, nuclear weapons yields of energy are measured in the amount of destruction that they would create as compared to tons of TNT. While bombs have been made in the 100 MT range by the USSR, such weapons probably wouldn't be used because smaller warheads are so much more efficient. Bombs in the 20-25 MT range may have been placed in both Western and Soviet arsenals several decades back. But these—if they were ever in the inventories of the East or West—are believed by most experts to have been phased out by now. It's generally believed that ICBM missile warheads currently in the inventories of both the US and USSR are only in the 100 KT to 1 MT range with possibly a few larger bombs being stocked by the USSR.

Therefore, even if you're living near a prime target, you should expect to receive a number of smaller warheads or bombs of 1 MT or less rather than one big warhead.

Another worry we'll forget is neutron and gamma ray radiation produced during the flash or initial burst of a nuclear weapon. While both are quite dangerous, they are dangerous only within the area where the blast wave is also very dangerous; thus, if you are unprotected from one, the other won't make any difference since you'll be dead anyway. Since you'd need to be in a blast shelter to survive the blast in the areas where initial radiation is dangerous, the density of your shelter's walls or its depth in the earth will also give you the shielding of protection which will stop the initial gamma rays and neutrons.

At any rate, while this initial pulse of radiation is in the thousands of REMs near ground zero, at 10 miles from ground zero it will have spread out and been blocked by air molecules to the point that the level of radiation will drop to 10 REMs—hardly enough to be noticed or—in and of itself—be dangerous. If you wish to do a little figuring later on to be sure you're protected from the initial pulse of radiation, here's how it breaks down:

INITIAL RADIATION LEVELS AT VARIOUS DISTANCES FROM GROUND ZERO

	3,000 YARDS	4,000 YARDS	5,000 YARDS	6000 YARDS
100 KT	11 REMs	0	0	0
1 MT	310 REMs	10 REMs	0	0
10 MT	30,100 REMs	2,753 REMs	100 REMs	8 REMs
20 MT	100,220 REMs	11,010 REMs	1,000 REMs	40 REMs

Neutron bombs or "enhanced radiation weapons" are designed to create slightly higher levels of initial neutron radiation and less blast. In general, however, protection from these weapons would be about the same: lots of mass between you and the source of radiation. Again, this is a case of being able to survive if you can survive the potential blast of a standard nuclear weapon. Too, the neutron bomb does not seem to be produced in any great numbers and would probably be used on the battlefield more as a tactical weapon than on civilian targets where the confusion created by rubble would be more advantageous to the attacker than massive casualties.

Currently some of the American press has the mistaken notion that neutron bombs create only radiation and no blast. This isn't correct. The neutron bomb only creates a larger amount of radiation and lesser amount of blast, but the blast is still quite devastating by conventional standards. (The idea that a neutron bomb would kill a city's population and leave its buildings intact is purely fiction. And, if such a result were needed, nerve gas would be used.)

Another new form of nuclear weapon currently being designed is the HPM (High-Power Microwave). Such a nuclear weapon is modified so that it will generate microwaves during its initial flash/blast stage. IF it can be perfected, it would have great potential both for damaging equipment as well as causing casualties.

While it will also create a blast, this will be minimal considering the range of the microwaves it generates. Experts believe that, should it become practical, a HPM weapon of 10 MT (again, rather large but possible) would generate a 2,000-mile radius of microwaves at a high enough level to damage many electronic circuits. Many think that the weapons might also be capable of damaging living tissues within this range and some speculate that a high enough level might be achieved to cause lethal "baking" of the human brain at closer ranges.

(Since the HPM is a theoretical weapon, no specific defenses have been proposed for it. It would seem, however, that the shielding of a standard shelter would be able to dampen microwaves to the point that they would not be dangerous to human life. It would also seem probable that grounded metal screening and foil would also be capable of stopping such signals. It would seem that the greatest potential for the HPM would be as a battlefield weapon where troops and equipment would be exposed to its effects when it was exploded.)

The bottom line to all this is that a citizen's big worry as to radiation during a nuclear war will be from that which will be drifting into an area in the form of fallout.

So how do you go about minimizing the radiation you will be exposed to?

The are three different ways you can block or minimize this radiation.

The first way is by moving away from the source of the radiation. This is known as "geometric shielding." The rule is: WHEN THE DISTANCE FROM A SOURCE OF RADIATION IS DOUBLED, THE AMOUNT OF RADIATION IS QUARTERED. Thus, if you're receiving 100 REMs per hour at one foot from the source of the radiation, moving to 2 feet from the source would reduce the amount you receive to 25 REMs per hour. Moving to 4 feet would drop the dosage to 6.25 REMs per hour. While this may not help much if you're in a small shelter, it would be of use if you were forced to take shelter in an urban environment (as you might be if you were traveling when war broke out). In such a case, being in a large building could be worked to your advantage by staying in the center halfway between the top floor and the ground floor. Doing so would give you geometric shielding from the fallout on the ground and that on the roof of the building. Moving to the center of the building or even to the hallway of a hotel would then give you geometric shielding from fallout on window ledges or coming from other buildings. Provided the building were quite large, you could enjoy a lot of safety in such a situation.

Geometric shielding can also be important in a small shelter. Suppose there is a high reading from one side of your shelter and it was caused by a "drift" of fallout just on the other side of the shelter wall. Moving to the other side of the shelter would drop the reading and greatly reduce your total dosage over a long time period.

(The principle of distance and reduced radiation can also be used to help locate a source of radiation or a "hole" in the shielding of a shelter so that it can be blocked.)

The second way of reducing the amount of radiation you receive is by time shielding. This has to do with the fact that as a radioactive substance "decays" the amount of radiation it is giving off drops. The rule for time shielding from fallout radiation produced by a nuclear weapon: NUCLEAR RADIATION DECREASES BY A FACTOR OF 10 WHILE TIME INCREASES BY A FACTOR OF 7. Let's again imagine that we have radioactive fallout which is giving off 100 REMS per hour. In seven hours it will only be giving off 10 REMS per hour. In 49 hours, 1 REM per hour, and so on. (As the radioactivity drops to very low levels, its loss will start to drop logarithmically; this is not a major concern, however, to figuring decay during a nuclear war.)

The chart below is handy to use in figuring out projected levels quickly. It starts out with 1,000. By moving decimals and "plugging in" the REM, milli-REMs, or whatever, you can work out the decay rates for various amounts of radiation. BUT it works only if you know when the initial explosion took place so that you can figure when the fallout was created.

To use this chart, you'll need to be aware of what time the original nuclear blasts creating the fallout occurred; the fallout won't get to your area for some time. So you must monitor the levels until they peak, then work up and down on the chart to predict what the radiation levels will be later on. Too, it's important to remember that you are dealing with THEORETICAL dose rates; real-life figuring could become very complex as additional fallout arrives in an area from distant blasts or is scrubbed from the atmosphere by rain or snow. Too, wind or rain will move fallout on the ground so that it drifts and/or becomes concentrated in low-lying areas.

(A little study of the chart will also show you that dangerous levels of radiation from fallout will sink to safe limits in a short time. This is surprisingly good news to many people.)

THEORETICAL DOSE RATES FROM EARLY FALLOUT

TIME (HOURS)	RELATIVE DOSE	TIME (HOURS)	RELATIVE DOSE
1	1,000	100	4

1.5	610	200	1.7
2	400	400	0.69
3	230	600	0.4
TIME (HOURS)	**RELATIVE DOSE**	**TIME (HOURS)**	**RELATIVE DOSE**
5	130	800	0.31
6	100	1,000	0.24
10	63	1,200	0.22
15	40	1,400	0.17
24	23	1,800	0.15
36	15	2,000	0.14
48	10	2,200	0.13
72	6.2	2,400	0.10

(Note: days are found by dividing by 24, months by dividing by 720.)

As an example of how you might use this chart, imagine that the level of radiation outside your shelter slowly rises following a blast until it peaks 6 hours following the explosion at 200 REMs. That's twice the 100 shown at 6 hours on the chart. So you will need to multiply all the radiation numbers by 2 to find out what the radiation level will be later on or what it was earlier. Thus, two days after the initial explosion, IF no new fallout has arrived in your area, the level should drop to (2 times 10 or) 20 REMs per hour. In a little over a month's time (about 800 hours) the level will have fallen to 0.62 REM per hour.

OK. But what will your total dose be?

Again, there are a lot of variables and these would probably make it quite hard to figure out the total dose. However, if you were in an area which received a very limited number of nuclear blasts, if the weapons were used simultaneously, if no secondary nuclear blasts occurred, and if you knew when the initial blasts took place, THEN you could figure the total dose by working your way back to what the initial fallout level would have been. Since the first hour's worth of fallout equals 55 percent of the total radiation it will be giving off, dividing the amount by 55 will show you what 1 percent of the total would be and multiplying by 100 will give you what 100 percent of the radiation dose will be without any type of shielding.

In our example above where the radiation peaks at 200 REMs at the sixth hour after the explosion, the first hour's value would be 2,000 REMs. Dividing that by 55 (the percentage of the first hour of the total) gives us 36.37 (or 1 percent); multiplying by 100 (to find 100 percent) gives us a total dosage of 3,637 REMs—which would probably be the worst-case amount you'd expect if you'd been within 30 miles and downwind from a 1 MT surface burst.

(For other ways to measure and project fallout amounts, see Bruce Clayton's FALLOUT SURVIVAL available from Paladin Press for $12. Do remember, however, when using his formulas and methods that they are theoretical; in an actual nuclear war, things would not be very cut and dried and "hot spots" would create dangerous areas even when levels in many areas would be at safe.)

All well and good. BUT 3,637 REMs is enough to kill you several times! How will you get through the first days or weeks while the levels of radiation are falling to safer levels?

For those who can't use geometric shielding, density shielding is the answer. There's no firm and fast rule for this one; the reduction of radiation by a heavy material varies according to its density. But it is possible to use a chart which "adjusts" the thickness of different materials to give an idea of how much material is needed.

These charts and tables are generally made to show how much material is needed to reduce the radiation to 1/10th or 1/2 of its original amount. (We'll use the "1/2 method" since that's the one I'm used to, not necessarily because it's better.)

The material needed to reduce an amount of radiation by one half is usually know as its HVT (or Half-Value Thickness). The following chart gives the approximate HVT's for your figuring:

HVT (HALF-VALUE THICKNESS)

Lead—0.3 inches
Steel (or iron)—0.7 inches
Aluminum—1.9 inches
Glass—2.1 inches
Standard concrete—2.2 inches
Firebrick (fireplace)—2.8 inches
Packed earth or bricks—3.3 inches
Sand or gravel—3.3 inches
Hollow cement ("cinder") blocks—4.4 inches
Water—4.8 inches
Ice—5.3 inches
Human body (average)—5.8 inches
Magazines (slick pages, stacked)—5.8 inches
Sheet rock (gypsum)—6.3 inches
Books or pulp magazines—7.0 inches
Hardwood (maple, oak, etc.)—7.7 inches
Pine wood—8.8 inches
Plywood (dry)—11.7 inches

Again imagine that you're in a "hot spot" where there's a lot of fallout. Now the really worst-case maximum amount of fallout that an area could have during an all-out nuclear war with a number of weapons exploding with ground bursts would range from 6,000 REM's to 40,000 REM's TOTAL (not REMs per hour but TOTAL amount over the radioactive life of the fallout). Remember that we're using unreasonably high rate of radiation to see what you'd need to face the very worst conditions.

Let's do our figuring and try to see what you'd need to reduce your total dosage to a safe level. We'll not worry about initial dosage, the decay rate of the fallout, etc., at this point. Rather, let's just look at the total dosage to get an idea of what would be needed to survive the very worst.

Now then, after studying the chart showing medical/casualty rates for various doses of radiation, we've found that 200 REM's is the highest short-term amount of radiation that a person can receive without noticeable ill effects. So that will be the upper limit that we'll try to reduce the 40,000 REMs maximum to.

To reduce 40,000 REM's to 20,000 we'd need one HVT for our imaginary shelter which we'll make of concrete for this exercise. So, using the HVT chart, we find that we'd need 2.2 inches of concrete to reduce the 40,000 REMs to 20,000.

To reduce the radiation by half again, we'll need another HVT of concrete. So another 2.2 inches of concrete added to the thickness of the shelter walls and ceiling would reduce the radiation to 10,000 REM's. At this point the total thickness of the shelter is 4.4 inches of concrete.

To reduce it to 5,000 REM's, 6.6 inches would do the job; for 2,500 REM's, 8.8 inches; 11 inches for 1,250 REMs; 13.2 inches for 625 REMs; 15.4 inches for 313 REMs; and, for our below-200-REM level (actually 157 REM's), we'd need 8 HVT's or 17.6 inches of concrete.

And this is THE very worst camping-out-behind-a-major-target case number.

You could, in fact, actually stand a higher than 200 REM total rate if it were spread over several weeks which is what it would be since the total 40,000 REMs would not occur at once but would be spread over time. If you're a healthy adult, many medical experts believe you could receive as much as 10 REM's per day for up to 3 months—a total of 900 REM's—without short-term adverse effects. Thus, the actual shielding you could "get by with" in our worse case figuring is actually 6 HVT's or just 13.2 inches of concrete!

While this might be cutting things a little close in our worst-case figure, it would be more than adequate for most situations and would be capable of getting you through the very worst. This shielding doesn't need to be created as a shelter, either. Many buildings without windows might have the needed thickness and below-ground basements in many areas would give you the shielding you needed for the sides of a make-do shelter (overhead you'd have to add some dirt, heavy furniture, metal tools, etc., to increase the shielding).

Thus, creating a shelter is not as hard as many people think and it need not be expensive. It could even be a hole in the ground covered with wood and earth. All you need is the right number of HVT's; the radiation being stopped isn't going to care how much your shelter cost.

Another point to keep in mind is that different materials can be coupled together to increase the density shielding of a shelter. For example, the earth a shelter is buried in would increase its shielding value and so would a house above it. (It should also be noted that solid glass bricks—because of their ability to cut down radiation while letting light through—might be used for adding a "skylight" to a shelter PROVIDED blast effects aren't a consideration. Another thing to keep in mind is the fact that people, huddled together in a shelter, could act as shielding for each other.)

Likewise, some of the supplies you may be keeping in your shelter can be placed along the shelter walls to add to your density shielding. For example, water containers could be placed along the walls or even shifted around to block off a "hot-spot" that might develop inside the shelter. Books, ammunition, tools, cans of food, etc., could all be used to cut down on your radiation exposure.

Note that water offers a lot of density shielding. This means that a river, lake, or ocean could be used as a "shelter." No, I don't mean camping out on the bottom of a lake; that would be the place NOT to be since the fallout would gradually settle to the bottom of the water.

The place to be with water is on the surface. The fallout sinks to the bottom of the water and the water shields you from the radiation if you're in a boat. Provided you have some way to wash fallout off a boat and into the water, a boat makes a very safe fallout shelter as would a house built over the water.

Large bodies of water aren't all fun and games, however. You don't want to be in a harbor when an attack comes. When water is deep, and you're well away from the fireball, the waves created by a nuclear explosion in the water aren't too awful; a boat rides up over the swell. But when the waves reach a shallow area, it looks like the first reel of the POSEIDON ADVENTURE. Waves generated by an underwater nuclear explosion near land pile up like a tidal wave. While underwater detonations would not probably be used much in warfare on the open seas (except for hunting large submarines or attacking aircraft carriers), nuclear weapons might be used to wipe out ships in a harbor.

For a rough idea of what would happen as waves hit shallow water, here's the wave heights created by an actual US test blast of 200 KT:

200 KT BURST AT 200 FT. BELOW WATER

DISTANCE (in yards)	330	1,330	2,700	4,000
WAVE HEIGHT (in feet)	94	24	13	9
TIME (in seconds)	11	49	101	154

If you're in a boat or along a large body of water, you'd do well to be sure you're not close to shallow water or the shore line where you could be buried by the tidal-wave-like effect. Too, the "tidal waves" will go on up the shore for quite a way; don't be too close to the water if you're near the ocean or a large lake.

The final consideration you need to make is how long you'll need to stay in your shelter. This will determine the amount of supplies you'll need to keep in, or close to, your shelter. Your physical needs will also have a lot to do with the size of shelter you'll need.

In the next chapter, we'll look at ways to figure out what the "targets" for a nuclear attack are in your area. Once you've found these, we'll then look at a quick way of figuring your TOTAL radiation dosage.

When you've found that figure, you will also want to have some idea as to how long you can work outside the shelter, etc. Finding the outside REM per hour level of radiation at "X" number of days after the initial attack is not too hard. To get a very rough idea of the level, you'll need to do the following steps:

First, you'll divide the total dose value you obtained from your map work in the next chapter by 100. This gives you one percent of the total dose.

Next, you multiply that number by 55 which will give you the first hour's figure for the fallout value. Once you have this, you can use the proportions to track down the levels at various times on the early fallout chart.

Let's try a problem. Suppose you discovered, after working with your maps in the next chapter, that the total fallout which might arrive in your area totaled to 15,200 REMs. Now, divide this by 100 to gain the one percent amount (which should be 152). Multiply this by 55 to get the first hour theoretical dose value (8,360 REM).

You could round 8,360 to 9,000 for ease and worst-case figuring but if you want to be accurate (such as it is with the rough degree of accuracy we're looking at with all the variables) you could use the 8,360. Let's go the hard way. To get 1,000 to the correct level, you must multiply it by 8.36 (that number is found by dividing 8,360 by the 1,000 of the first hour). Multiplying any of the figures on the chart by 8.36 will show the level you could expect that hour following the initial blasts. (Again, remember that this is all very theoretical and allow yourself extra leeway when figuring.)

Now, things get complicated (I never said I'd make this easy!). You need to figure out how much exposure you'll receive if your shielding protects you by whatever amount you decided on. Then you will be able to see how much exposure you could stand to pick up and check various levels on the chart. Remember that exposure over several month's time can be considerably higher than over a few day's and that a short stay outside will give you a very low dosage as compared to the per hour dose level.

Assuming that you haven't received a massive dose of radiation beforehand and that your shelter was heavily shielded, the following chart may serve as a VERY rough rule-of-thumb as to what the MAXIMUM time that might be spent outside a shelter.

AVAILABLE TIME IN CONTAMINATED ENVIRONMENT

Outside Reading	Maximum Time of Exposure Outside Shelter
Less than 0.2 REM/hr	Outside 8.5 hours per day
0.2 to 0.5 REM/hr	Outside 4.2 hours per day
0.5 to 2 REM/hr	Outside no more than 1 hour per day
2 to 10 REM/hr	Outside no more than 12 minutes per day
10-50 REM/hr	Outside no more than 3 minutes per day or

	total of 21 minutes per week
50-100 REM/hr	Outside no more than 1.5 minutes per day 10.5 minutes per week
100 REM/hr	Do not go outside of shelter unless not doing so would mean your death

This chart gives only a rough idea of how long you could be outside. You should keep careful track of total radiation exposure rather than "guesstimating" in order to avoid radiation sickness. While you could probably take much more radiation without ill effects, I feel limiting your exposure to a total of 15 REM per week would be wise and this would only be IF the levels of radiation are falling and if you'll not be exposed to new, high levels of radiation a short time later because of subsequent nuclear explosions and fallout. Too, if you have received large amounts of radiation in the weeks before, you would be wise to lower the above maximums. Remember: the less radiation you are exposed to, the less injury your body will sustain from it.

In an actual contaminated environment, you'd also need to be very careful about decontamination procedures and carefully monitor and log the total dose of everyone who goes out of your shelter (decontamination procedures will also be covered in later chapters).

Until radiation levels have become very low, a good rule of thumb is to NOT go out of the protection of your shelter unless it is absolutely necessary to do so for your survival. Save up your exposure time; you may really need it and will be less apt to contaminate your shelter with tracked-in radioactive fallout.

One surprising effect created by nuclear weapons is EMP (Electro-Magnetic Pulse also sometimes called "NEMP" or Nuclear Electromagnetic Pulse). EMP was kept secret from the public for a long time. Even now, information about it is a little sketchy.

EMP occurs with all nuclear explosions but is normally absorbed by the earth so that its range is more or less that of the blast and heat wave of such a weapon. But the effect becomes more pronounced and wide spread in high-altitude blasts where there isn't a "ground" to soak up the free electrons produced. In such a high-level explosion, when gamma radiation is released during the flash cycle of the nuclear weapon, the radiation will react with air molecules and strip electrons free from them, producing electromagnetic radiation similar to broad band radio waves (10 kHz-100 MHz) in the process. These electrons follow the earth's magnetic field and quickly move toward the surface of the earth where they are finally grounded. ("Surface EMP" or "SEMP" refers to ground bursts with limited-range effects while "High-altitude EMP" or "HEMP" is the term sometimes used for blasts which would create large amounts of EMP.)

Because the magnetic field of the earth tends to spread EMP out, one 20-MT bomb exploded at an altitude of 200 miles would blanket the whole US with the effects of EMP. And the electrical surge produced by the free electrons would be strong enough to knock out much of the civilian electrical equipment over the whole US! Since just one bomb can do so much damage, such high-altitude explosions would probably be used to initiate any major attack on a country and would have great potential as a terrorist weapon as well. (The fact that several of the US Military's EMP testing facilities are being closed down at the time of this writing because of environmental concerns compounds the probability of wartime use of nuclear weapons to create EMP.)

It's possible to avoid much of the damage done to electrical equipment by EMP, however.

Although the results of EMP are much like lightning strikes, EMP is actually more akin to a super-powerful, broad-band radio wave. It travels at the speed of light so you must be prepared to avoid its effects BEFORE you are aware of nuclear flash.

EMP in the levels created by a nuclear weapon does not pose a health hazard to plants, animals, or man PROVIDED it isn't concentrated. EMP can be dangerous if it is concentrated by metal girders, large stretches of wiring (including telephone lines), long antennas, or similar set ups. To avoid being fried by such concentrations, it would be a good idea to stay at least 8 feet away from large bodies of metal or long stretches of wire if there may be a nuclear war about to erupt.

How about protecting electrical equipment? Because of the concentration of EMP by home wiring, any electrical equipment that is plugged in—even if not turned on—would probably be damaged by EMP. However you could avoid damage to much of your electrical equipment by unplugging it IF you know beforehand that a nuclear war might be in the offing.

From a design standpoint, "hardening" equipment is ideal but often hard to carry out. The National Academy of Sciences found in the late 1980's that tailored hardening is "not only deceptively difficult, but also very poorly understood by the defense-electronics community."

Nevertheless, there are some methods which will help to protect circuits from EMP. These include the use of tree formation circuits (rather than standard loop formations); the use of induction shielding around components; the use of self-contained battery packs and loop antennas can eliminate the chance of pulling in an EMP surge from power lines or long antennas; the use of grounding wires for each separate instrument which is coupled to another can also reduce EMP damage by increasing the paths an electrical surge can take to ground itself; the use of Zener diodes has also been shown to have merit in protecting solid state components from EMP.

One new automatic switch which seems to hold promise in saving electronic components from EMP damage is the Ovonic threshold device pioneered by the Energy Conversion Devices of Troy, MI. The Ovonic threshold device is a solid-state switch which opens to ground a circuit when a massive surge of electricity—or EMP—occurs. Should this device be perfected and become readily available, it would seem to hold promise in easily making electronic equipment EMP-proof.

Some of the most EMP-resistant electrical equipment includes electric motors, vacuum tube equipment, electrical generators, transformers, relays, and the like. These would be pretty sure to survive the EMP pulse if you had the foresight to unplug them and remove long antennas (if any) from them.

At the other end of things are the really sensitive electrical parts such as IC circuits, microwave transistors, and Field Effect Transistors (FET's); be prepared to write off such equipment if it isn't protected in a Faraday box (more about this later).

Explosives connected to electrical discharge wiring or designed to be set off by other electric devices might also be exploded by EMP. While less apt to be ignited, ammunition, mines, etc., especially in large quantities might also be prone to damage or explosion by EMP.

Antennas longer than 30 inches are apt to pull in a damaging surge of EMP even if not connected to household wiring. Radios, "walkie-talkies," CB's, etc., should have their antennas disconnected or retracted to 30 inches or less if you expect a nuclear war. Also, check the schematic of any electrical equipment when you buy for the sensitive parts listed above.

Sensitive equipment can be stored so that it can survive EMP in a Faraday box. A Faraday box is a metal box designed to divert and soak up the EMP. If the object placed in the box is insulated from the inside surface of the box, it will not be effected by the EMP. (According to sources who have worked in the US Defense Nuclear Agency in Washington, DC, the Faraday box is not only the simplest and cheapest way to protect many electrical components but also the most reliable since many "hardened" circuit designs have not been adequately tested.)

A lot of containers can be used as Faraday boxes: cake boxes, ammunition containers, metal filing cabinets, etc. The only two requirements are that the equipment inside the box does NOT touch the metal container (plastic, wadded paper, or cardboard can all be used to insulate it from the metal) and that the metal shield is continuous without any gaps between pieces or large holes in it. (Boxes do not have to be airtight, however.) Ideally, the Faraday box would be grounded. This does not, however, appear to be absolutely necessary (non-grounded boxes might hold a slight charge for a longer period of time than a grounded box,).

Another easy way to create a Faraday box is to keep the packing box that equipment comes in and cover the box with copper foil, aluminum foil, or metal screen. Place the foil-wrapped box inside a larger cardboard box so that the foil isn't accidentally ripped anywhere and the equipment can be stored safe from EMP damage, ready for use following a nuclear war.

You don't have to think small, however. A whole shelter can be turned into a Faraday box by lining it with copper or aluminum foil and covering the air vents with metal screen. If you do this, be sure the screen and the foil on the doors are all connected to the foil on the wall so that the covering will act as a continuous shield (if some portion is not in electrical contact with the others, it's possible that EMP will enter the area and do some damage). Add a heavy carpet to the floor of your "Faraday shelter" so occupants won't be in contact with the metal covering and be sure that equipment in the shelter doesn't contact the foil lining.

The "catch" to such a shelter design is that you can't have metal cables, pipes, or antennas going through the shielding of the "Faraday shelter" since stretches of metal coming into the shelter would defeat its protection from EMP. One way around this is to use plastic coupling between metal conduits or metal air vents. Optical fibres couplings and surge arresters should be installed where electrical connections must penetrate the shelter wall. (It should be noted that surge arresters have become less than ideal since EMP from modern weapons has shifted to shorter wavelengths which can get through surge arresters before they can react. Consequently, these devices are becoming more or less obsolete for counteracting EMP. Likewise, lightning arresters—sometimes recommended in older CD literature or by experts who haven't kept up with modern developments—are also more or less useless in stopping EMP.)

Most cars and trucks are EMP resistant because they have parts that aren't overly sensitive to EMP and the metal car body soaks up some of the surge of energy so that it doesn't damage the electrical system. But newer cars with a lot of IC circuits or other "computers" to control essential changes in the engine might be damaged by EMP. Some electronic ignition systems might also be damaged. If you have a car that might be zapped, buying the sensitive spare parts and keeping them in the truck inside a Faraday box would allow you to get your car going following a nuclear attack. Learn what parts of your vehicle are sensitive and how to replace them.

Perhaps one of the more horrifying things about nuclear reactors in the US is that a little-known Federal dictum prohibits the NRC from requiring power plants to withstand the effects of a nuclear war. Because of this, nuclear reactors are NOT made to withstand an EMP surge (new plants may be required to have such a design feature but, should this become the law, it probably will not be retroactive so that plants in operation will remain vulnerable). This means that an EMP surge might knock out the core-cooling controls and, thereby cause a core melt down and breaching of the containment vessel to vent large quantities of radioactive materials into the surrounding area. A word to the wise: living downwind from a nuclear power plant is not a good way to survive a nuclear war.

At the time of this writing, it is believed that the USSR is working on developing generating equipment which creates EMP by non-nuclear means. Such equipment would be used as a sort of beam weapon, and might achieve high enough levels to damage equipment or even cause injury to personnel. Such weapons would, again, probably be limited to battlefield use and would probably have more limited range than nuclear-induced EMP. As such, this EMP should not be confused with that created by nuclear weapons.

Whether dealing with nuclear-induced EMP, blast, or fallout, the bottom line is that, whether you're in a hole in the ground, a tall building, or out at sea in a ship, a little knowledge and preparation would enable you to survive.

TARGETS

Before you race downstairs or out back and start building a shelter, it's a good idea to do a little figuring to see just what you might be facing. Doing your thinking and planning beforehand will allow you to start out in the right direction rather than going to a lot of expense and having to re-do things later.

As we've seen, the larger 20 MT bombs will be the rare if nonexistent upper level of threat that you'll need to worry about with the 600 KT to 1.5 MT-sized warheads being the most common worry for most of us. So you'd actually need to worry about being close to a 20 MT bomb only if you're near a very prime military target. (In fact, many experts believe that the US W53 used in the Titan II ICBM may be the largest nuclear weapon in actual service; it has a yield of 9 MT.)

As we've seen, even if you were near a 20 MT bomb, you'll still be able to survive without a blast shelter up to within 15 miles of ground zero (and to within a few miles in a reinforced concrete shelter). With weapons up to 1 MT size, you could survive a blast up to within 5.5 miles of ground zero without a blast shelter as long as you took care not to be in the way of flying debris; at eight miles you could survive outside of a blast shelter provided you "ducked and covered" to protect yourself from cuts from flying debris and skin burns from the thermal pulse.

On the flip side of things is the fact that an area might be saturated with a number of smaller warheads. This would allow an enemy to create the destruction of a large bomb with the lighter weight and expense of a number of smaller weapons. This effect will be similar to that of a larger bomb (though many of the blast effects will overlap the target area and, in effect, cancel out much of their danger to surrounding areas). There is no way to estimate the area covered by such multiple attacks but (I feel) for rough figuring on a worst-case basis, a 15-mile-radius of destruction would be a good "yardstick" to use in figuring. (If you'd prefer to use another distance, just substitute it in the figuring below.)

The first consideration then is whether or not there are any major targets within 15 miles of your home or place of work. Probably the best way of discovering how close targets are to you is to get a map of your state and of those states neighboring you to the north, south, and west (unless you're less than 15 miles from the state east of you, you'll not need to worry about blast or fallout effects from that direction).

Probable targets to look for include power plants, industrial centers, airports, harbors, and military anythings. I would suggest that you also add large cities—with populations greater than 75,000—to your list of possible targets. While many suggest that cities wouldn't be targets, it doesn't seem prudent to gamble your life on it since cities are ideally suited to strategic attacks designed to break the will of a country to fight or for a terrorist/hostage type attack. It would be wise to avoid serving as part of a terrorist's object lesson.

(While thinking of cities as targets, you might want to consider what will happen if there's ever a threat of a war and the supply lines feeding into a city are disrupted. There's only enough food to go around in most cities for three or four days; things could get pretty tough in a city even if it weren't attacked during a war. Imagine the insanity if the gas, water, and electricity were off and there weren't any food coming in.)

At any rate, one quick way of seeing how dangerous an area might be is to use a compass (the type you draw circles with) to locate the targets around you and, using the map's legend to measure 15 miles with the compass, determine if you're within 15 miles of any of the targets. If there is nothing that close, you won't be needing a blast shelter to survive an attack.

If you discover that you are within 15 miles of a target, you probably still won't be needing a blast shelter but you'll have to weigh the chances you wish to take to decide whether or not you need to build a blast shelter or want to "chance it" and settle for a cheaper fallout shelter.

You now have circles on your map showing the 15-mile radius of damage that you could expect if targets around you were attacked. Provided none of the circles overlap your area, surviving the blast of the weapons will be fairly easy and your house will probably only suffer minor damage and some broken windows. This is because even a frame house—which is not nearly as strong as a brick or concrete structure—can survive the blast of a 1 MT burst with moderate damage to within 5.5 miles of the blast.

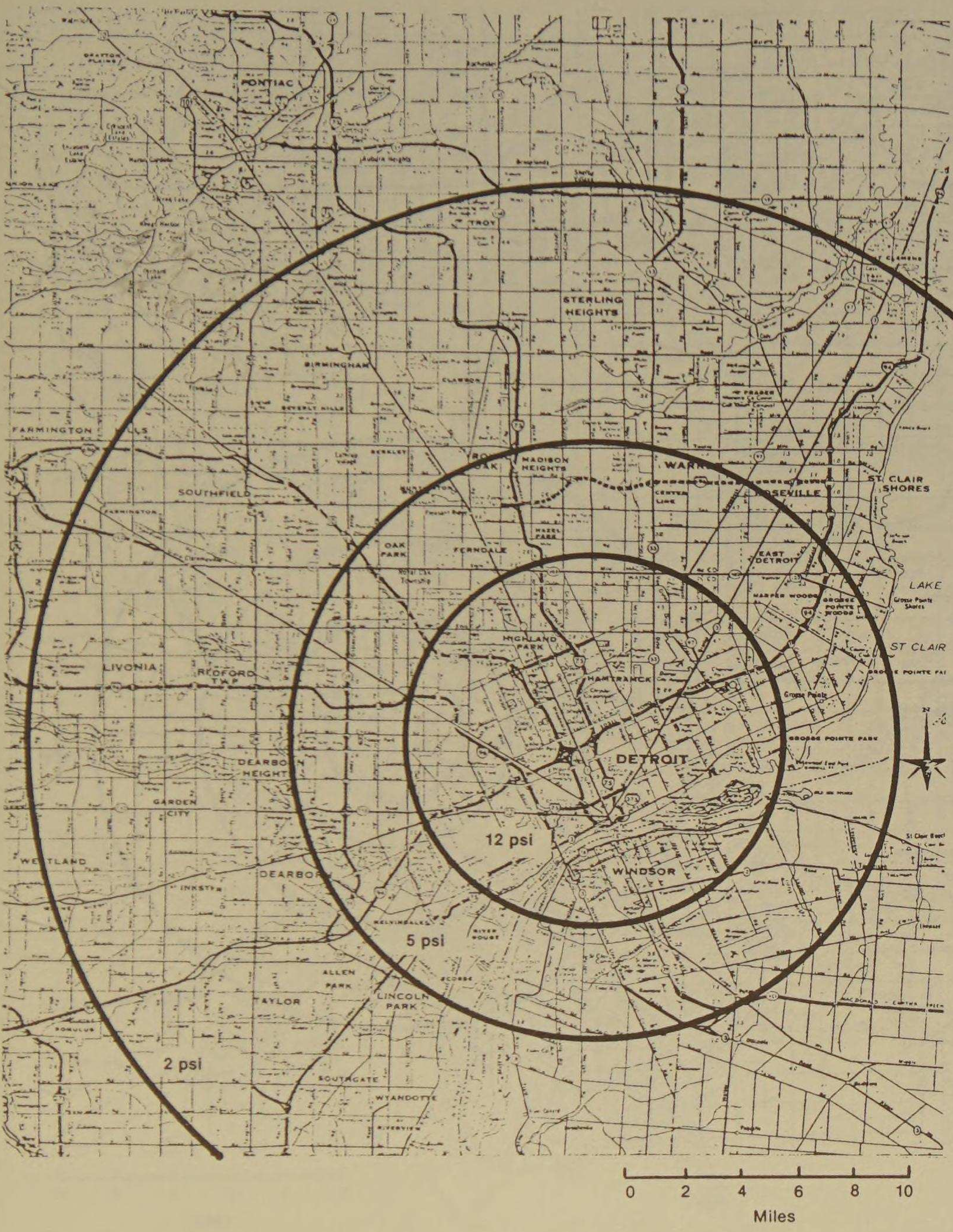
Now, what about fallout? Let's do some rough fallout predicting.

There are a lot of maps in nuclear survival books and other survival books which purport to show how fallout will drift and where the safe spots in the US are. The only problem with such maps is that they would have to be updated from day to day to be accurate given weather changes; too, some of the maps are quite dated and show targets that aren't there anymore as well as missing obvious military and industrial complexes.

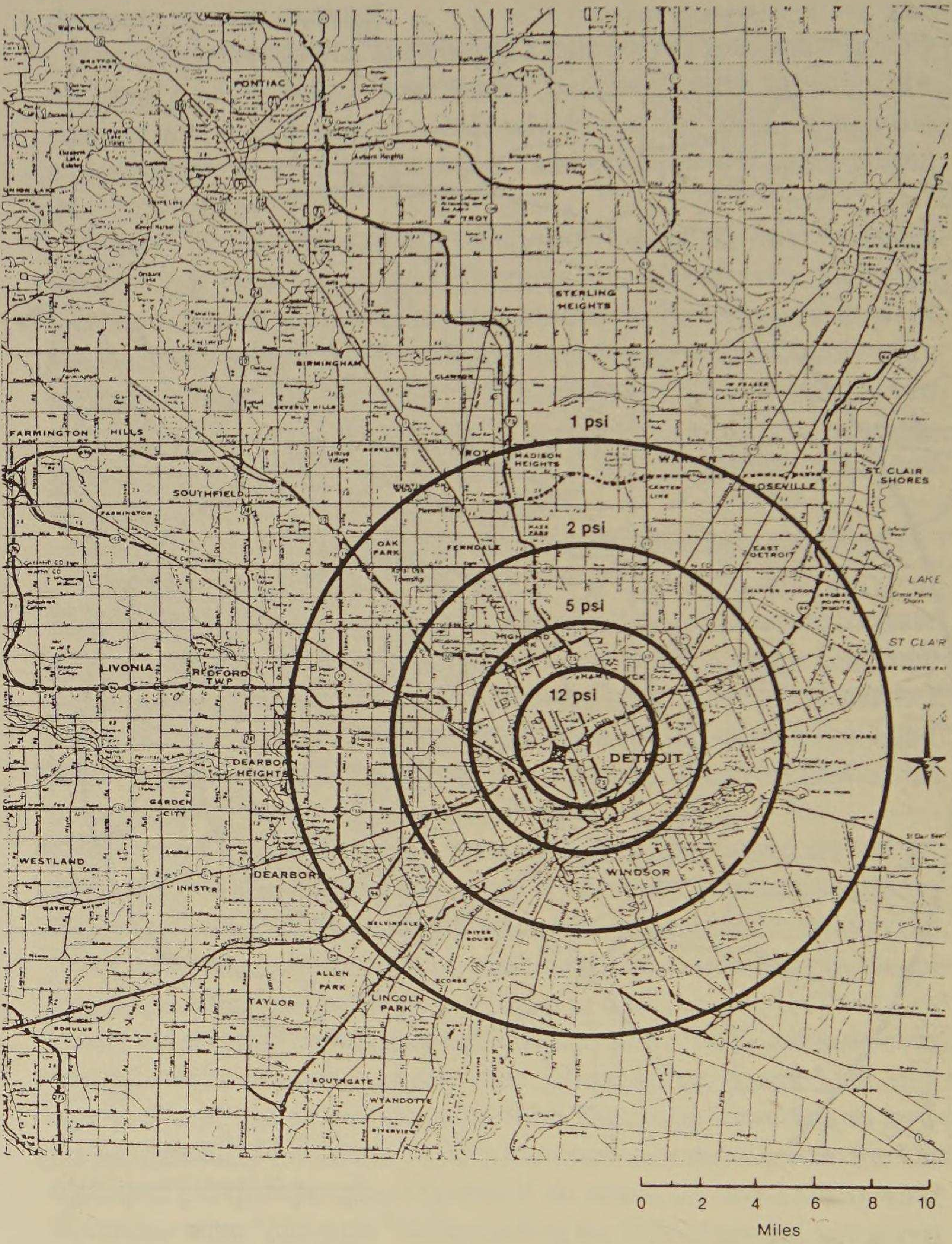
Since each wind shift would change the pattern of fallout and might turn what was an ideal spot one day into a hotbed of radiation the next following a nuclear attack, these maps aren't too reliable, though the better ones may point out targets you've missed in searching out local targets (just be sure the target map is up to date).

As the drawings included in this chapter show, wind patterns over several weeks' time can greatly alter where fallout drops. One area can be free of contamination or terribly dangerous according to how the breezes carry the fallout dust. In fact, virtually anywhere in the US mainland COULD be contaminated if an attack occurred when wind directions were "just right" for spreading the fallout toward any given location.

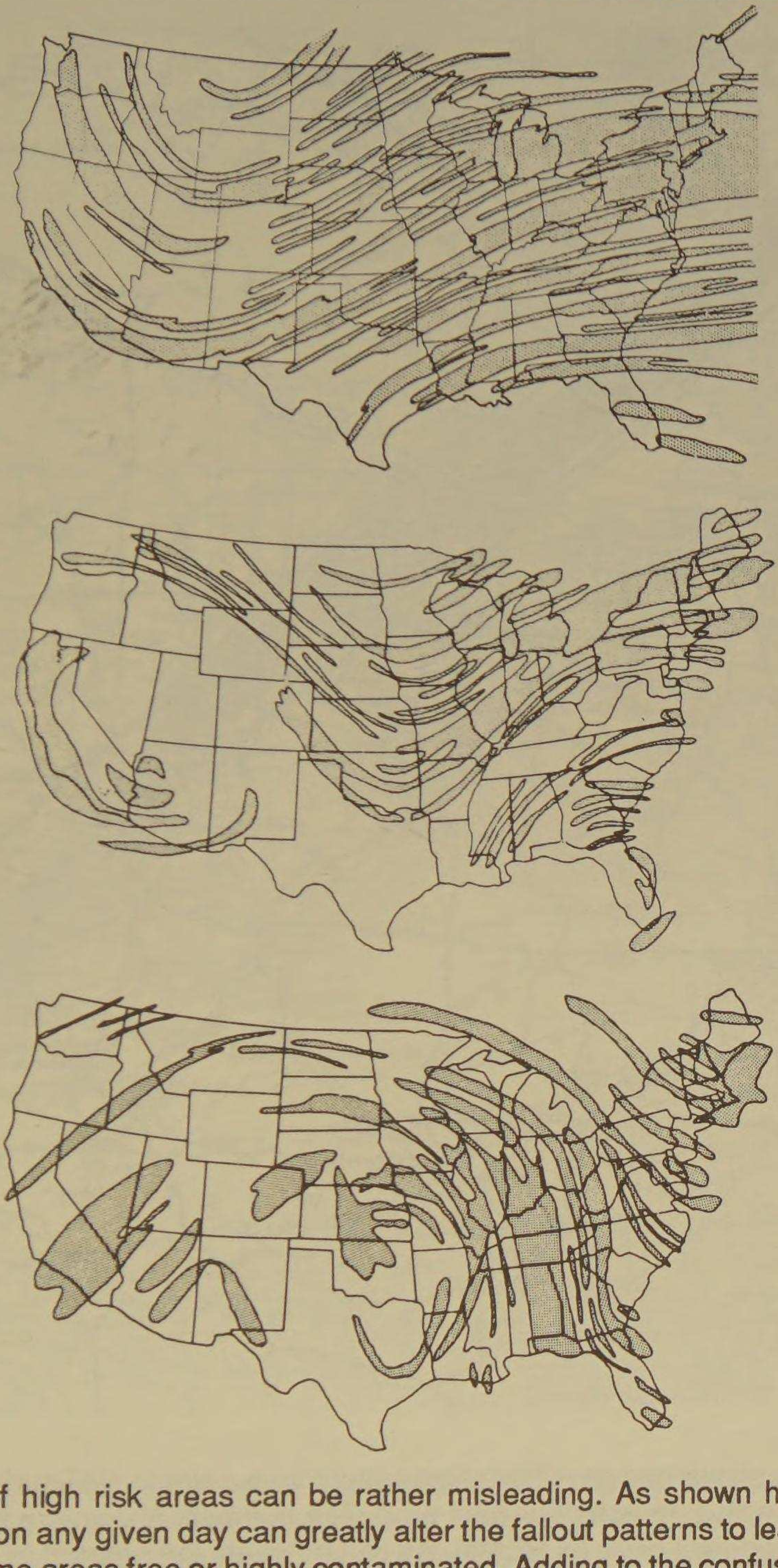
Thus, although possibly as much as 25% of the US won't receive a dangerous amount of fallout even in an all-out nuclear war, there's no


PONTIAC
TROY
STERLING HEIGHTS
BIRMINGHAM
FARMINGTON HILLS
SOUTHFIELD
ROYAL OAK
MADISON HEIGHTS
WARREN
ROSEVILLE
ST. CLAIR SHORES
OAK PARK
FERNDALE
EAST DETROIT
LAKE
ST CLAIR
HIGHLAND PARK
HAMTRAMCK
LIVONIA
REDFORD TWP
DETROIT
DEARBORN HEIGHTS
GARDEN CITY
WESTLAND
DEARBORN
INKSTER
WINDSOR
12 psi
MELVINDALE
RIVER ROUGE
5 psi
ALLEN PARK
ECORSE
TAYLOR
LINCOLN PARK
ROMULUS
2 psi
SOUTHGATE
WYANDOTTE
RIVERVIEW
0
2
4
6
8
10
Miles

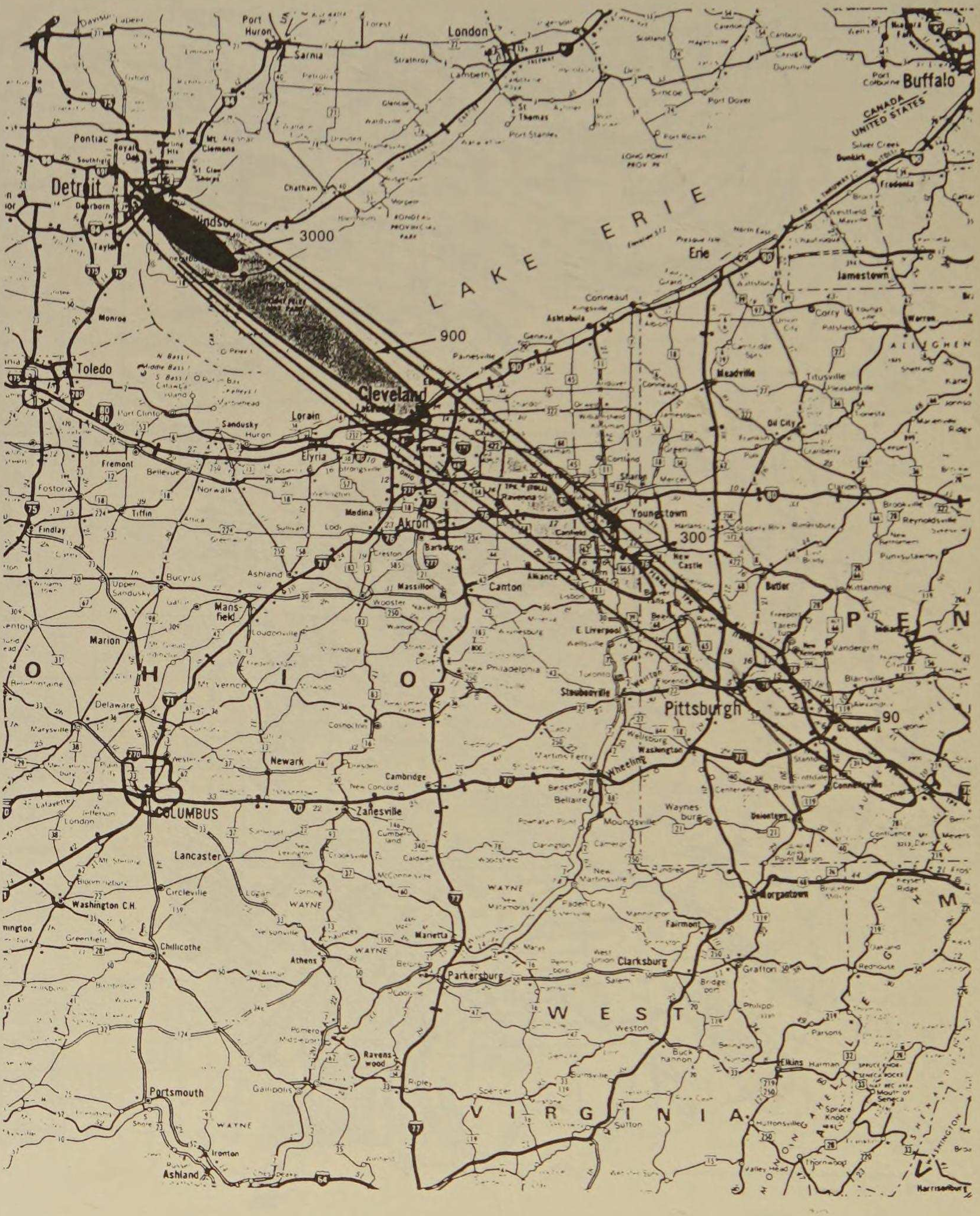
This map shows the probable ring of destruction which would occur from a 25 MT air burst over Detroit. What few people realize is that 25 MT bombs are almost non-existant in today's arsenals. Even so, a person could survive to within several miles of ground zero if adequate shelter were available.


PONTIAC
TROY
STERLING HEIGHTS
BIRMINGHAM
CLAWSON
FARMINGTON HILLS
1 psi
ROYAL OAK
MADISON HEIGHTS
WARREN
ST. CLAIR SHORES
SOUTHFIELD
ROSEVILLE
CENTER LINE
2 psi
OAK PARK
FERNDALE
EAST DETROIT
LAKE ST CLAIR
HARPER WOODS
GROSSE POINTE WOODS
5 psi
HIGHLAND PARK
HAMTRAMCK
LIVONIA
REDFORD TWP
12 psi
GROSSE POINTE PARK
DETROIT
DEARBORN HEIGHTS
GARDEN CITY
WESTLAND
DEARBORN
INKSTER
WINDSOR
WAYNE
MELVINDALE
RIVER ROUGE
ALLEN PARK
ECORSE
TAYLOR
LINCOLN PARK
ROMULUS
SOUTHGATE
WYANDOTTE
RIVERVIEW
0
2
4
6
8
10
Miles

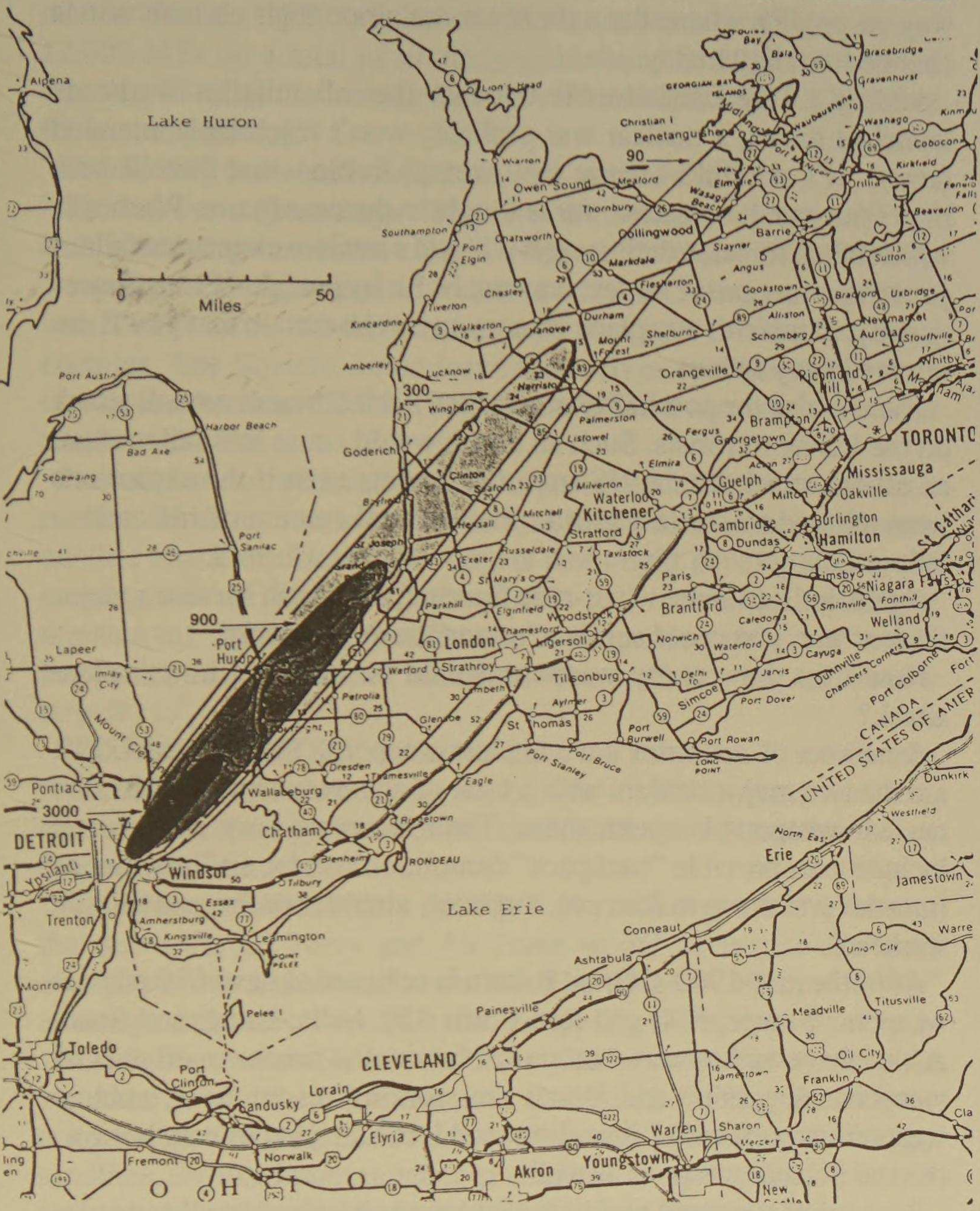
This map shows the more likely ring of destruction which would occur from a 1 MT air burst over Detroit. Buildings beyond the outer ring would suffer little damage other than broken glass. Nuclear flash might cause some fires beyond the outer ring but the blast wave following it would probably extinguish most of them.



Maps of high risk areas can be rather misleading. As shown here, wind patterns on any given day can greatly alter the fallout patterns to leave some of the same areas free or highly contaminated. Adding to the confusion is the probability that many warheads would fail to accurately hit their targets.


3000
900
300
90
LAKE ERIE
CANADA
UNITED STATES
Detroit
Pontiac
Windsor
Monroe
Toledo
Sandusky
Lorain
Cleveland
Elyria
Akron
Canton
Youngstown
Mansfield
Marion
Pittsburgh
Wheeling
Zanesville
Newark
COLUMBUS
Lancaster
Chillicothe
Portsmouth
Ashland
Parkersburg
Clarksburg
Morgantown
Erie
Jamestown
Buffalo
London
Sarnia
Port Huron
Chatham
Fremont
Bucyrus
Tiffin
Findlay
Fostoria
Delaware
Cambridge
Steubenville
New Castle
Butler
Meadville
Oil City
Ashtabula
Conneaut
O H I O
P E N N
W E S T V I R G I N I A

This map shows one possible fallout pattern from a single 1MT surface burst on Detroit with a 15mph northwest wind. The numbers shown are the 7-day accumulated total dose (in REMs). As can be seen, the amount of radiation would be quite high—3000 REMs—close to Detroit while it would sink to only 90 REMs by the time the cloud of fallout reached Pittsburgh. Interestingly, those to west of Detroit would receive very little fallout.


Lake Huron
0
50
Miles
90
300
900
3000
DETROIT
Pontiac
Port Huron
Windsor
Chatham
London
Kitchener
Waterloo
Guelph
Cambridge
Brantford
Hamilton
Burlington
Oakville
Mississauga
TORONTO
Owen Sound
Goderich
Stratford
St Thomas
Lake Erie
Erie
CLEVELAND
Toledo
Akron
Youngstown
CANADA
UNITED STATES OF AMERICA
O H I O

This map shows one possible fallout pattern from a single 1 MT surface burst on Detroit with a 15 mph southwest wind. The numbers shown are the 7-day accumulated total dose (in REMs). As can be seen from these two maps, a prudent planner uses a compass to determine possible fallout dangers rather than simply extending imaginary patterns to the east since wind patterns are unpredictable.

way to predict where the safe spots are since high altitude winds change from day to day.

Adding to the confusion is the fact that all missiles warheads launched during a nuclear war probably won't reach their intended targets. It's possible—many feel even probable—that there'll be a high error rate if a nuclear war is fought in the near future. Warheads which fail to travel to their targets will add a random element to fallout patterns; many prime targets may not be hit by nuclear blasts. Consequently, there isn't any place where you can be certain that you'll not receive heavy fallout.

There is also the possibility of a limited nuclear war or a small attack on the US by terrorists. Such an attack would cause less fallout than an all-out attack on the US from the Soviets even if the explosions were tailored to create a greater-than-normal amount of radioactive fallout.

Again, let's do some worst-case figuring; if you can survive a major nuclear war, you could survive "minor" terrorist attacks.

Now then, how many weapons would be involved in a nuclear attack?

A number of countries have nuclear weapons. The US and USSR are the two major holders with a total of somewhere around 25,000 nuclear weapons between them. Their weapons vary in size and include man-portable "backpack" demolition bombs, artillery rounds (most of which are in Europe), torpedos, aircraft bombs, and missile warheads.

As of the mid-1980's, Great Britain is believed to have 686 nuclear weapons; France, 514; and Red China 330. India, Israel, and South Africa have unknown—but probably small—numbers of nuclear weapons. Argentina and Brazil are working on, or have, nuclear weapons as well with Libya, Iraq, and Iran all trying to beg, borrow, or steal nuclear weapons as well.

Because of the small numbers of weapons involved in all countries but the US and USSR, for those living in the US, the USSR or terrorist attacks are about all that need to be feared at this point.

What, then, would be the maximum number of nuclear weapons that might fall into the US during a US/USSR nuclear war? As of the mid-1980's, the USSR is believed to have warheads totaling to around 12,000 MTs on a total of in the neighborhood of 10,800 warheads (bearing in mind that no one outside of the USSR REALLY knows the exact numbers).

Would they launch all of these at once toward the US?

The answer is (probably), "No way." While the Soviets would still have short-range nuclear weapons, they wouldn't have the long-range weapons they might need to counter both the Chinese on one flank and NATO forces on the other as well as a host of other potential enemies. The Soviets would leave themselves open to attack from countries other than the US if they expended all their weapons in their attack on the US.

It would seem realistic, then, to expect the USSR to save back a number of its nuclear weapons so that it could continue to threaten another attack or disable new targets that might develop during the ensuing war. If the USSR were unable to fire a second round (or threaten to), the Soviets would have no bargaining chips and would be open to a counter-attack with little hope of "following up" on new targets.

Too, many of the Soviet missile silos are reusable. It would take some time to get such a silo set up for a second shot; this, too, encourages a strategy that uses waves of attack spread over time rather than a massive initial salvo.

Not all targets would be in the US. Various foreign ports and bases that serve the US Navy and Air Force would be targets as would aircraft carriers and submarines at sea. The USSR would need to "hit" as many of these as it could or risk a crippling US counterattack.

For all these reasons, it's doubtful that all the Soviet nuclear weapons would be fired at the US at one time. Even if the Soviets should have a few extra warheads hidden away from the eyes of capitalist spy satellites, the maximum number of warhead headed at the US would probably be in the neighborhood of 5,000 for a total of 6,000 MT.

Would all the weapons be used for ground bursts? That's possible if the Soviets were more interested in creating casualties rather than damage. But how wise would that be? Survivors would have more equipment and supplies to support them if the aim were to create a minimum of physical damage and a maximum number of casualties, especially in the initial few hours of a nuclear war. It must be remembered that the object of any war is to destroy your enemy's ability to fight back, cause an enemy to desist what he's doing, or make him unable to resist what is to be done to him. The object is not to kill off all the enemy's population (and the few attempts to break an enemy's will with such tactics have met with dismal failure in the past).

Therefore, except for hardened military targets and perhaps air fields, air bursts are much more destructive and cover a larger area, which would make them much more successful in disrupting the US than ground bursts and more apt to make it impossible for the US to support conventional warfare. Lack of fallout would also make it easier for invading troops to enter the US.

It's therefore probable that ground bursts would be reserved only for hardened missile silos and key areas where political leaders might be holed up in shelters.

So if you want to have a realistic worst-case figure, don't create ground bursts and fallout unless the target really is hardened and would warrant such an attack. (There is a difference between "worst-case" and "unrealistic," after all.)

Now the figuring gets tricky. Dangerous levels of fallout from a ground burst will stretch out for about 280-300 miles downwind from a ground burst in a more-or-less elliptical pattern 20-60 miles wide. (You'll need to do your figuring on a map or maps that give you a picture of what could be 300 miles up wind from you.) Because the wind is unpredictable, you'll need to locate all the targets some distance up wind from you to the southwest, west, and northwest of you. (Due to prevailing winds in the US, unless a target is within 20 miles to the east of you, it is very doubtful that it would produce fallout that would come into your area.)

Though the prevailing winds in the upper atmosphere (which are the winds which will be drifting the fallout down range from the blast) go from west to east in the US, that's only more or less west to east. To take this variance into account, you'll want to create wide half circles extending out from targets (with the flat side of the half circle pointing west) rather than using the elliptical fallout patterns that actually occurs. This will allow you to ignore the variations in wind direction.

Don't panic yourself by using the figures for the larger explosions shown below for a number of the ground bursts. I've included the 20-MT explosion so you'll be able to see what the very worst of fallout might be. You must remember that the Soviets are believed to have only 100 weapons larger than 5 MT. Therefore, don't saturate an area with large warheads unless it is really one of the prime targets for the US which would need to be attacked by a ground burst. SAC air bases; NORAD; Washington, DC, MIGHT be targeted such large bombs; downtown Podunk, USA, won't.

Many targets could be expected to receive more than one small warhead, however. There's no way to figure just how many would be sent to any one target. But assuming that around 5,000 warheads would be heading toward the US, the average number of missiles per state would be 100. Spread those out over the various targets in your area (keeping in mind that some states would undoubtedly warrant a bigger share of weapons while other less-settled states would get fewer).

Use the legend of the map of your state (and maybe of neighboring states) and measure and draw half circles extending from the targets you've located (you may have to draw these "free hand" rather than with a compass). Make the half circles 300 miles in radius to see how fallout patterns overlap and come into your area. When you're done and get ready to calculate potential amounts of fallout radiation, keep in mind the fact that patterns which overlap from different directions could not occur since the wind won't blow in two directions at once.

Again using the legend of the map, measure the distances of the targets from you and then use the tables which follow to find the total fallout radiation that could occur from a ground burst at the target area. As you find each amount, write it down. When the fallout from all the targets has been found, total it up. (You may have to do this procedure several times to find the different amounts that might occur if the wind blew from different directions.)

Note that the amounts of radiation shown below are given in the approximate TOTAL amount of radiation and that the fallout patterns are quite long—you may need to use a ruler rather than a compass to plot things. Because of the variables of height of the burst ("ground bursts" can occur up to several thousand feet off the ground and still produce fallout), wind spread, weather conditions, terrain, etc., the two charts give VERY APPROXIMATE amounts of fallout that you might expect to receive and tend to err in the "worst case" end of the scale.

20-MT EXPLOSION: DOWNWIND FALLOUT LEVELS

Downwind (Miles):	0-70	70-100	100-160	160-220	220-280	280-340
Total Dose (REMs):	29,000	3,500	1,200	350	120	60

(Note: The above fallout pattern would tend to be elliptical and 60 miles wide at its widest point IF cross winds weren't present.)

2-MT EXPLOSION: DOWNWIND FALLOUT LEVELS

Downwind (Miles):	0-20	20-40	40-60	60-80	80-140	140-180
Total Dose (REMs):	50,000	4,000	1250	375	125	38

(Note: This fallout pattern would tend to be elliptical and 20 miles wide at its widest point IF crosswinds weren't present. Wind speed 15 MPH.)

1-MT EXPLOSION: DOWNWIND FALLOUT LEVELS

Downwind (Miles):	0-20	20-40	40-60	60-80	80-140	140-180
Total Dose (REMs):	18,200	1,280	390	128	40	15

(Note: This fallout pattern would tend to be elliptical and 20 miles wide at its widest point IF crosswinds weren't present. Wind speed 15 MPH.)

Except for the area within 20 miles of ground zero, don't expect a total of more than 40,000 REMs. If you get more than that, you've either been too pessimistic, made a mistake, or are camping out on the White House lawn.

(If you want to really get down to the nitty-gritty of the effects created by nuclear weapons and have a math background, get a copy of Glasstone, Samuel, and Dolan's THE EFFECTS OF NUCLEAR WEAPONS published by the US Departments of Defense and Energy. The book should be available in most any public library or from the US Government Printing Office, Superintendent of Documents, Washington, DC 20402.)

Once you've "explored" the map and done some figuring, you'll have as accurate an idea as is possible of what to expect in the way of the worst fallout that might enter your area. With this figure, you can go back to the table of HVT's in the previous chapter and figure out what type of shielding you'll need when you start to build your shelter. Using the other tables will allow you to figure how long you might need to remain in your shelter and how much in the way of supplies it should have room for.

If the blast and/or fallout that would be in your area is too large for your tastes, then you may wish to move out of your area altogether. This would be an option PROVIDED you can actually find a new job and afford to make such a change.

If you decide you'd be wise to relocate and can do so, you must be careful not to jump from the frying pan into the fire. Give some careful thought before accepting a new job and/or looking for a new home. Be sure to do a little studying. A topographical map—available in most public libraries—of the area you're thinking about settling in can be quite an eye opener, too: flooding could be a problem in areas where large numbers of plants were killed so that erosion might create high levels of water not normally encountered in an area.

When "checking out" an area, also watch for structures which might pose a danger following an initial attack. For example, an untended dam could quickly flood low-lying areas in a nuclear war. Nuclear reactors or industrial areas processing or storing hazardous chemicals should also set off the alarm bells in your head.

If you decide to move, buying a secluded farm wouldn't be too wise.

Such a spot might be safe from nuclear attack and would be capable of supplying food following a nuclear war but would be hard to defend from looters or scavengers in the aftermath of a war. If you wish to purchase rural land, be sure it's very close to a town and has a number of nearby farmsteads which could be used to create a loose alliance for defense during the aftermath of a nuclear war.

The best compromise between a city and a farm is a small community. You'll need one that will allow you to make a living and which has enough different jobs so that the people can build a barter economy of their own following a war. Too, the area should be surrounded by farms which could exchange food for the goods the town will have to trade. Towns which have "Farmer Coop" grain elevators would be most ideal since they will often have large supplies of grain stored in them which might be used by the owners to barter with the local survivors.

The bottom line is this: a home in a small community in a good location will improve your chances of surviving a nuclear war. (Population isn't always a fair way of figuring a community's "size" but a small city of only 1,000 to 8,000 people would seem ideal.)

One more thing: don't plan on bugging out of a dangerous area to a safer one. Most people (including the US Government), when they first start figuring ways to survive a nuclear war, plan on fleeing. Unfortunately, running away is not a good way of dealing with most problems and nuclear war is no exception. While you might "bug out" from your place of work to your home that you commute from, fleeing from your home to a wilderness area or the like isn't viable.

For one thing, traveling ahead of the unprepared folks evacuating an unsafe area wouldn't be too easy. At the hint of real trouble, cities often start an automatic evacuation as people realize they're in danger. These impromptu evacuations are far from orderly. So you'd have to time things perfectly and be aware of the danger before others were.

The second big problem is that it's almost impossible to carry out enough gear and food with you to survive a nuclear war. Even if you are quite skillful at living off the land, hunting, etc., that won't give you much of an edge during a nuclear war since you'd have to be holed up in your make-do shelter for a long time and when you come out, a lot of the plants may not be fit to eat and many of the animals sick and dangerous to eat.

Too, could you carry out what you need to start a whole new way of life? How are you at starting a garden with just what you'll carry out to your retreat area? If you could find enough to eat, how long before some group—or even the owner of the land—would come along and take "your" land away from you? Gardening with a rifle in one hand while a sniper has you pinned down for hours at a time isn't too easy. And what happens if someone else beats you to your ideal retreat. Are you willing to fight for it?

Fleeing an area might work for some, but I think the best strategy is to move to a small town that can support its citizens and which would allow them to band together if they needed to.

SHELTER

If a nuclear war ever occurs, your shelter is your ticket to tomorrow. To work well, a shelter must be large enough to accommodate everyone that may be in it. A person needs about 10 square feet of floor space to be able to keep his sanity in a confined space. Your shelter must also have room to store water and food for at least the first few weeks of your stay in it (the rest of your supplies might be placed just outside the shelter or in a hall leading to it). And try to have some extra space in case you have to take someone else into your shelter like a visiting relative or friend.

Be sure you have enough room in your shelter and remember that it will be getting 24-hour use for a number of days, weeks, or even months. It's a little late to discover you need more room in your shelter after the concrete forms have set on your too-small shelter.

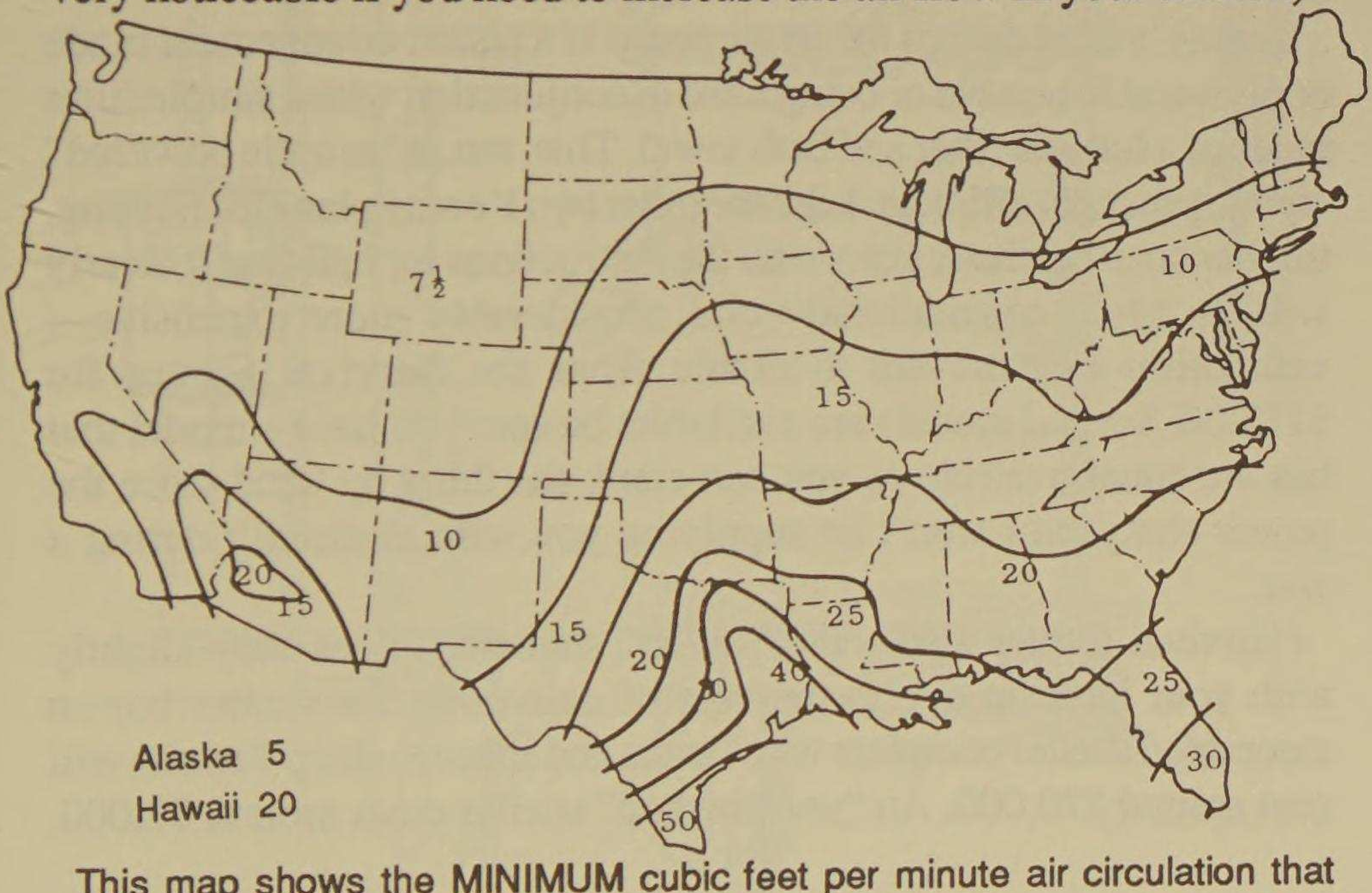
There is an additional concern that a lot of people often overlook; there should be enough air flowing through the shelter to remove excess heat created by the shelter occupants' bodies. This is an important consideration; during some tests of shelters, especially during the summer, the occupants have had to evacuate the shelters several days into the tests because the occupants were in danger of dying from heat stroke!

What happens to cause this heat buildup?

People give off small amounts of heat—about like a small light bulb. Normally the air surrounding people carries the heat away. But when minimal amounts of air aren't flowing through the area the people are in, body heat builds up in the air and the objects in contact with the heated air.

This condition doesn't create any problems for several days in a small shelter (the time depends on how much shielding the shelter has and the ground and air temperatures). The shelter walls soak up the heat. Thus, short stays in the shelter are comfortable. But if the stay goes on for several days, somewhere down the line the shelter will absorb all the heat it can and will start radiating heat back into the shelter. At this point things heat up quickly. In such a case during a nuclear war, you'd have the choice of being killed by radiation or heat exhaustion.

The way to avoid this heat buildup is to have enough air moving through the shelter to supply a minimum of 25 to 50 CFM (Cubic Feet per Minute) per person in the southern US and Hawaii and a minimum of 8 to 20 CFM per person in the northern states and Alaska. (Air needs will be at the higher level during the summer and in the lower ranges during the winter.) This air supply will also be more than adequate for your air needs. (Not having enough air will result in symptoms of carbon dioxide poisoning: panting, headaches, etc. These will become very noticeable if you need to increase the air flow in your shelter.)



This map shows the MINIMUM cubic feet per minute air circulation that would be needed in a shelter to prevent heat build–up during warm weather. Failure to maintain adequate air circulation will quickly lead to heat stroke for those staying in the shelter.

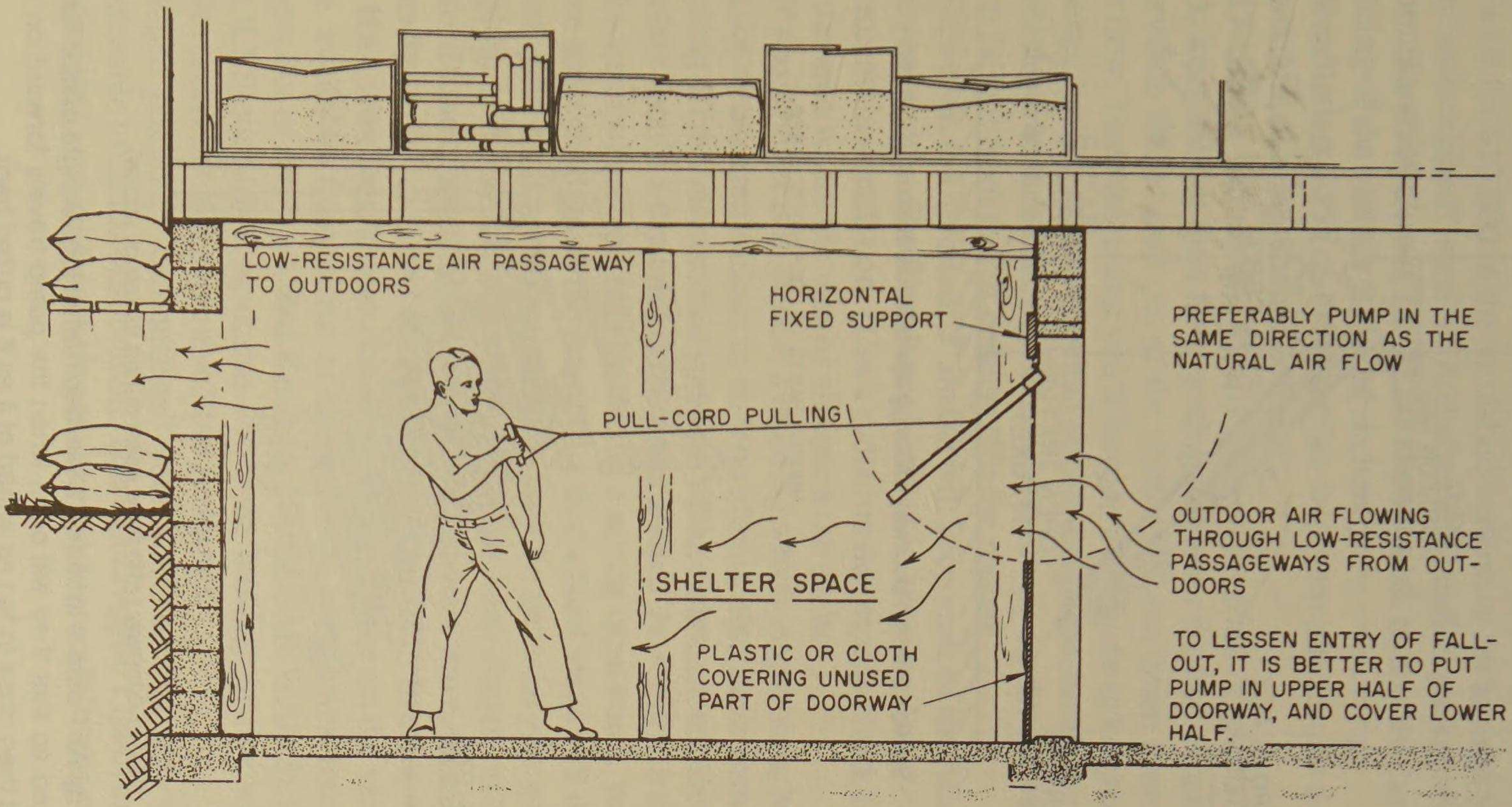
An adequate ventilation system, then, is essential for your survival. Commercial fans are available for this purpose and several good fans can also be constructed in a pinch from household materials. Cresson Kearny has developed some fanning systems which cost little to create.

Perhaps the simplest system was rediscovered by Kearny when he was researching how miners ventilated mines in areas or times when there was no electrical ventilation system. This type of fan can be created with a large piece of thin plywood, canvas, or even a large piece of cardboard. Such a system is moved with its edges vertical while its surface is toward the direction the air is to be pushed. After pushing the air forward, the fan is rotated so that it is horizontal and moved back with a minimum of air movement and rotated to the vertical position to start the fanning cycle again. One or two people can use this method to move large volumes of air through a shelter with very little effort and no special equipment other than scrounged materials.

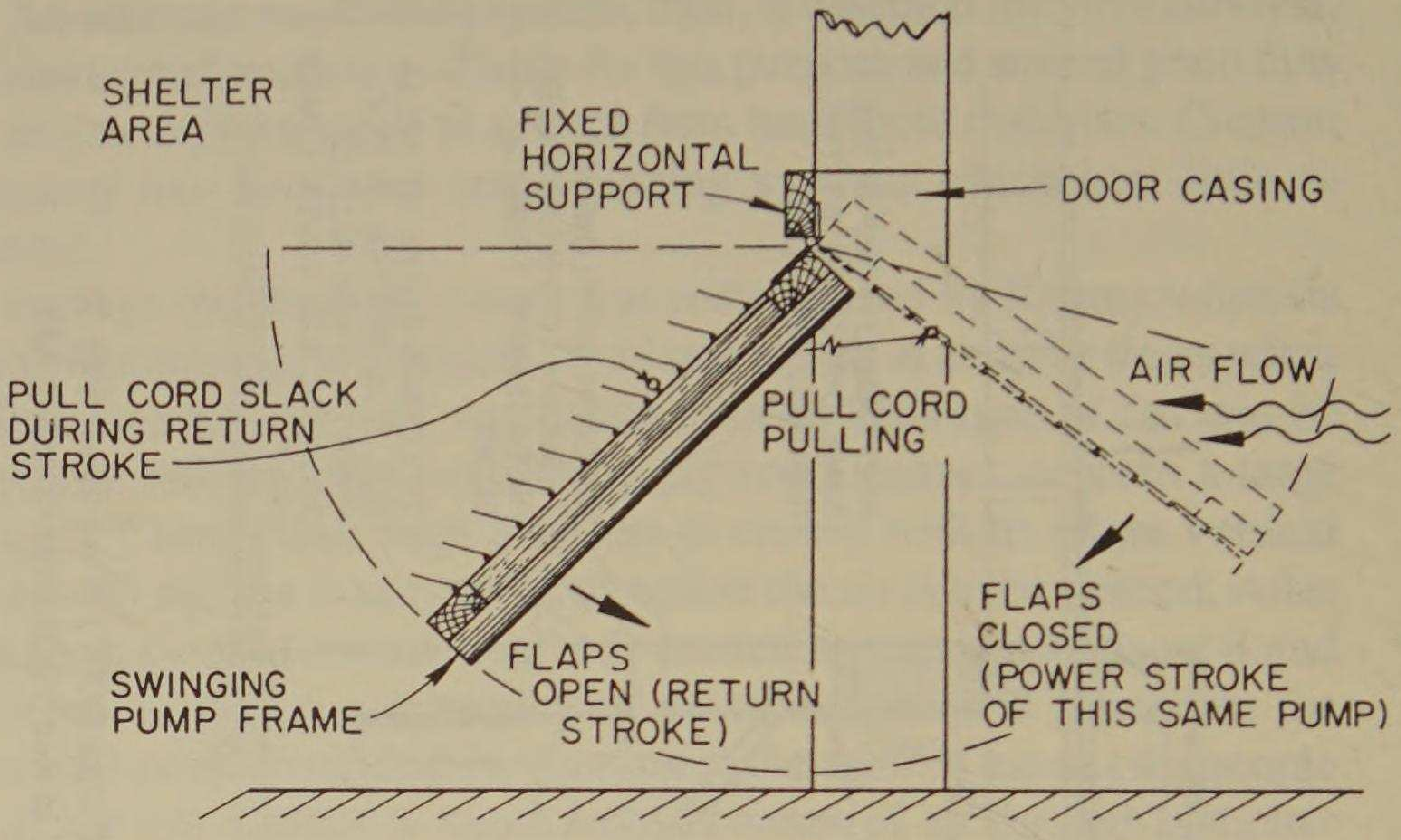
Another good system is the Kearny Air Pump (see diagram). This system consists of a number of long, flat "valves" or blades which open when the fan moves one direction and then close to push air ahead of them on the opposite swing of the fan.

Kearny's third design for an air pump is a piston arrangement made of plywood is capable of being used in conjunction with a simple filter made of a furnace filter and bath towel. This, too, is "muscle powered" and surprisingly efficient. Like the other two Kearny plans for fanning, this has been carefully tested and the instructions for building it clearly written. More conventional—and considerably more expensive—ventilation systems are available from the Survival Center for $113.00. Several models are available; be sure you have a model that has a manual override so you can crank the thing by hand since the power companies won't be supplying you with electricity during a war.

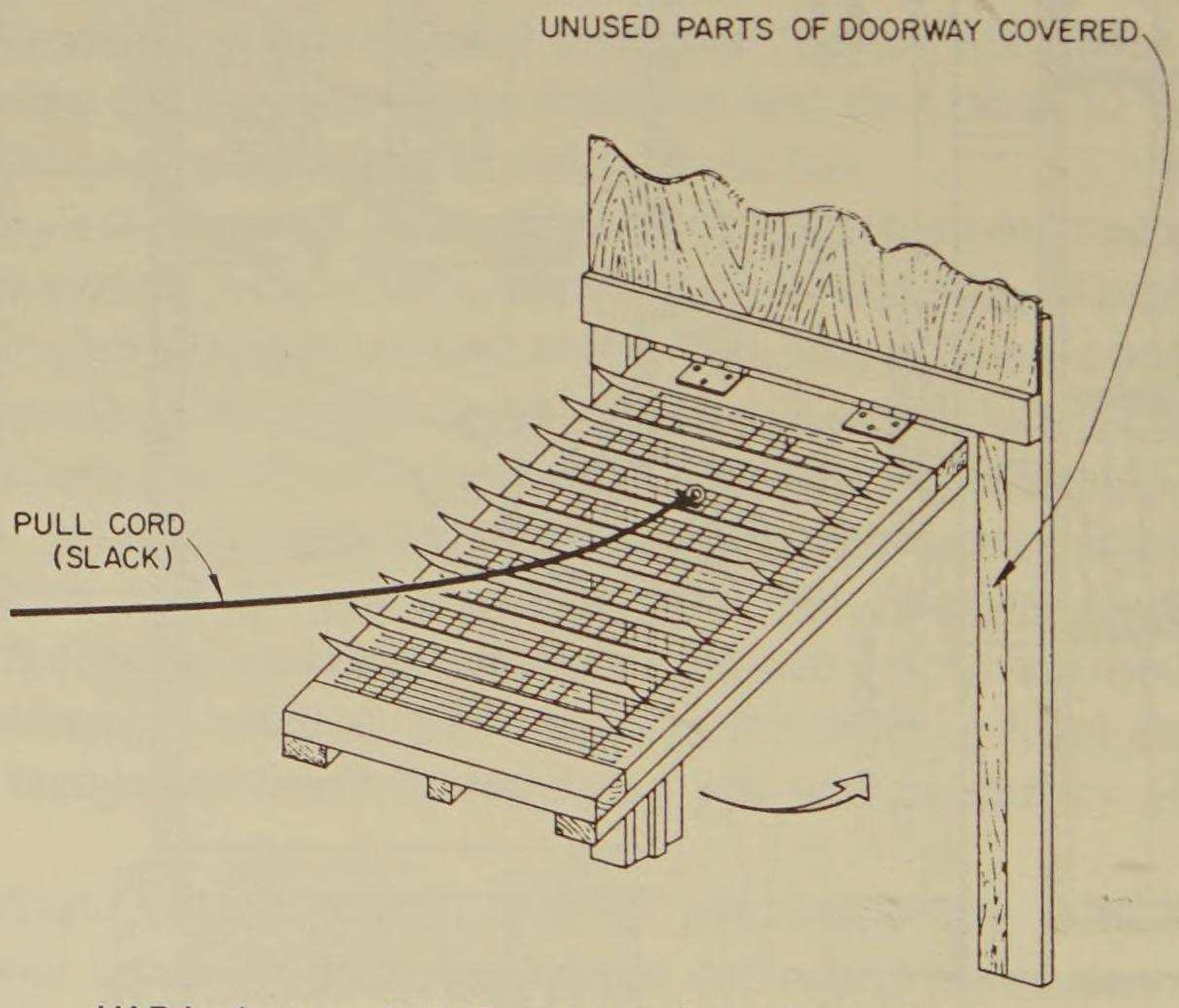
(Survival Center also sells "prefab" shelters. Prices vary slightly with your location due to the cost of delivering the shelter but an assembled shelter complete with bunks and space to sleep 7 adults will cost around $20,000. An "unfurnished" shelter costs around $8,000.


LOW-RESISTANCE AIR PASSAGEWAY TO OUTDOORS
HORIZONTAL FIXED SUPPORT
PREFERABLY PUMP IN THE SAME DIRECTION AS THE NATURAL AIR FLOW
PULL-CORD PULLING
OUTDOOR AIR FLOWING THROUGH LOW-RESISTANCE PASSAGEWAYS FROM OUTDOORS
SHELTER SPACE
PLASTIC OR CLOTH COVERING UNUSED PART OF DOORWAY
TO LESSEN ENTRY OF FALLOUT, IT IS BETTER TO PUT PUMP IN UPPER HALF OF DOORWAY, AND COVER LOWER HALF.

If time permits building one, a Kearny Air Pump (KAP) is an ideal way to maintain the amount of air circulation needed to keep a shelter comfortable.


SHELTER AREA
FIXED HORIZONTAL SUPPORT
DOOR CASING
AIR FLOW
PULL CORD SLACK DURING RETURN STROKE
PULL CORD PULLING
FLAPS CLOSED (POWER STROKE OF THIS SAME PUMP)
SWINGING PUMP FRAME
FLAPS OPEN (RETURN STROKE)

Section through doorway showing operation of Kearny Air Pump.


UNUSED PARTS OF DOORWAY COVERED
PULL CORD (SLACK)

KAP in doorway (with flaps open during its return stroke).

The Kearny Air Pump is made on a wooden frame. Lightweight plastic flaps are arranged so that they will open when the pump travels forward on its hinges and then close to fan air ahead of it as it is pulled back.

If you have the time and skill to do the work, the shelter is available as a kit for $13,000 in the furnished version or for around $6,000 for the "unfurnished" version. A shelter information packet is available from Survival Center for $2.00 if you wish to see the layouts and pricing of the various styles of shelters.)

Ventilation ducts to bring the air into your shelter are a potential weak link in many shelter designs.

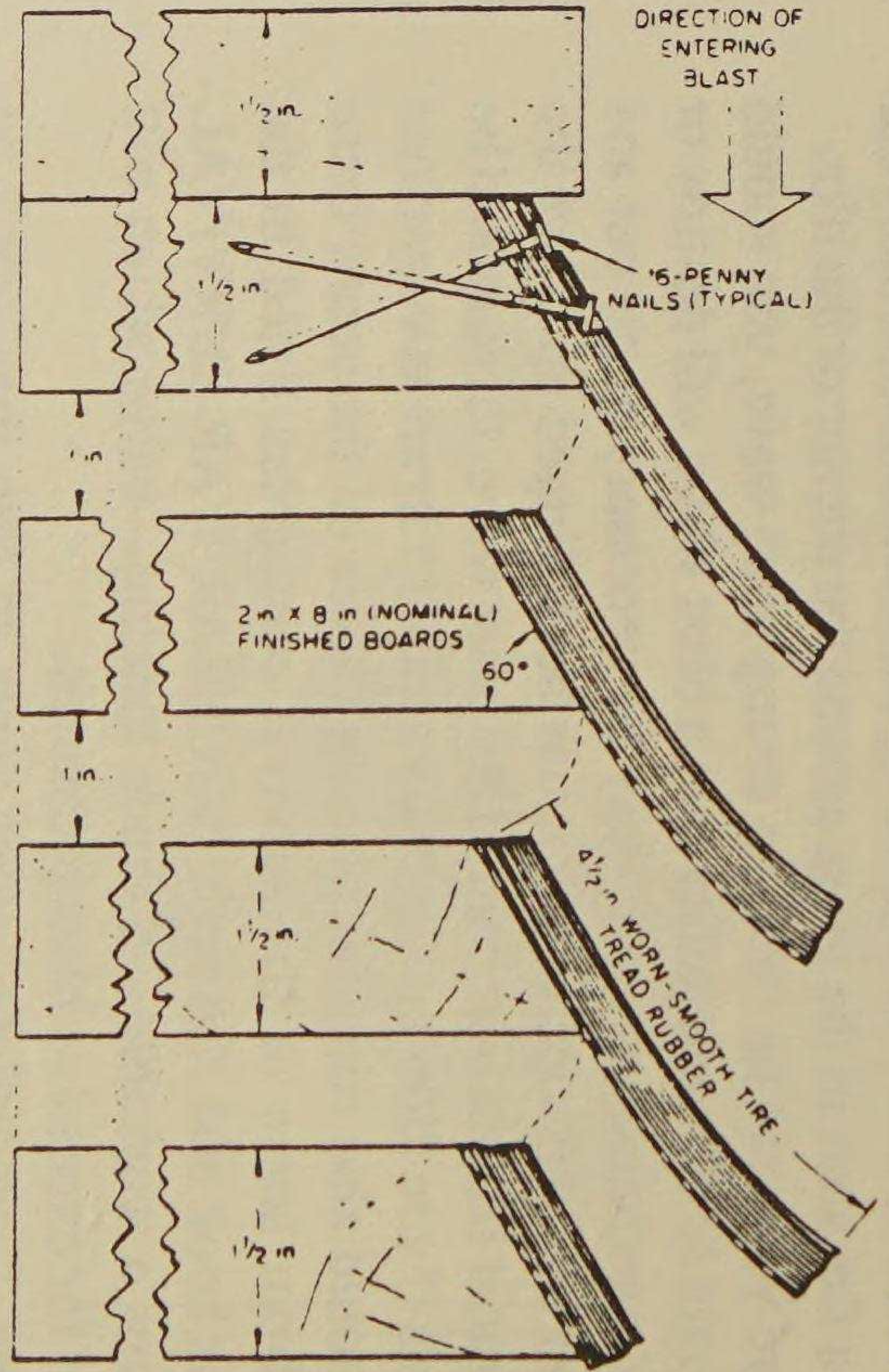
The intake vent should ideally have an inverted "J" or "U" crook in it to keep fallout dust from getting into your shelter. Filters to keep very fine fallout dust out of the shelter will cut down greatly on the air flow. That means that you'll have to work more to keep cool in the shelter; but that might be a small price to keep from breathing in fallout particles. Furnace filters (or even a bath towel) can be used to remove fine fallout from the air coming into the shelter.

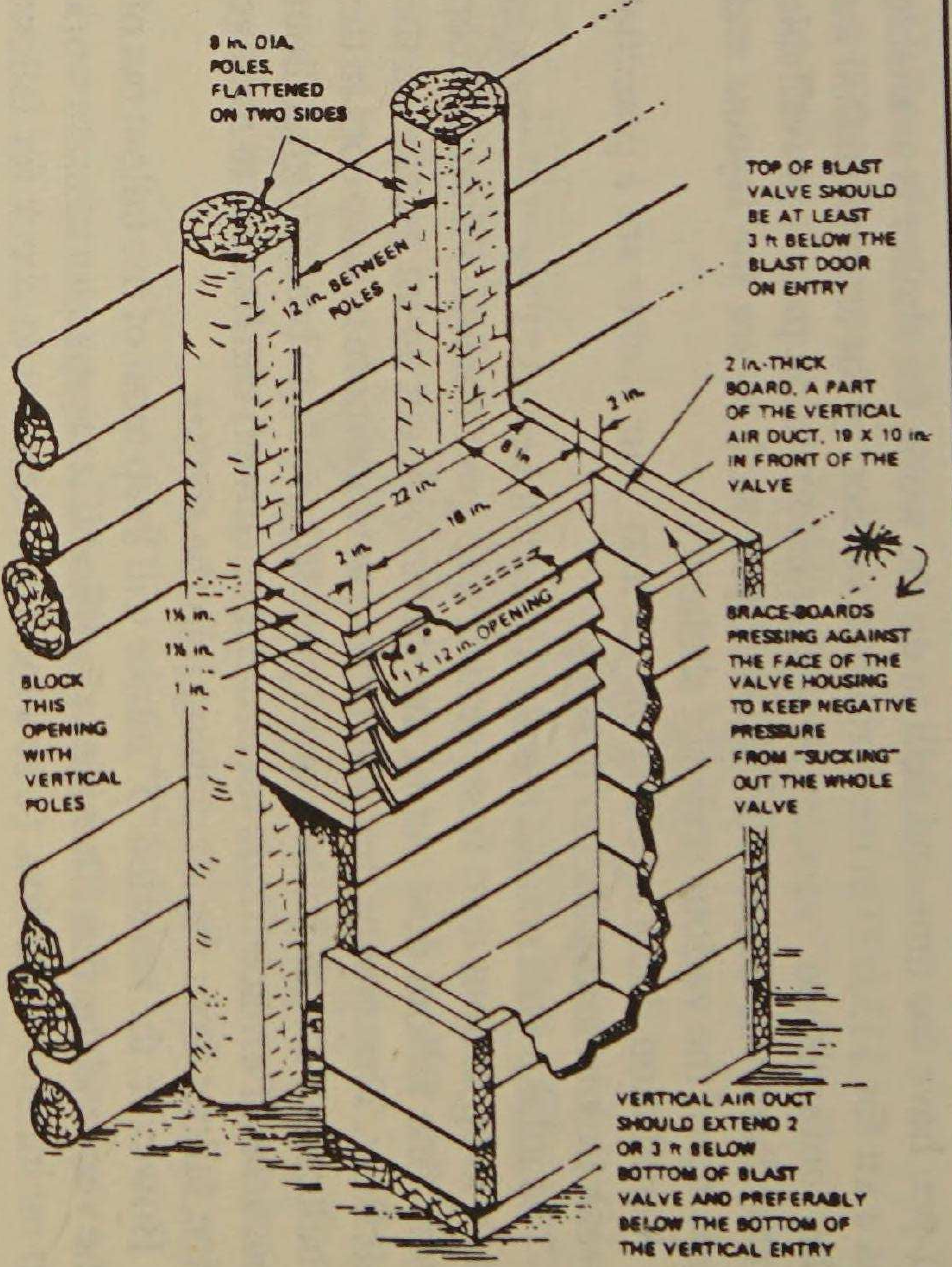
However, the inverted "J" intake will keep most of the fallout out of the vent and the fine filter is not justified if it means a lot of extra work to maintain ventilation. (Use a radiation detector to check for fallout at the area where the vented air enters the shelter.)

If your shelter is in or near a building which might burn, be sure the intake vents aren't close to it. You should also have some way of sealing off the vents so that you won't drag carbon monoxide into your shelter should a fire start in the grass around the shelter or the like.

In areas where you may be facing a strong blast wave, you should give some thought to the possibility that a blast wave will destroy or bend your intake/exhaust vents. It may be necessary to go out and replace or repair the vent opening if it has been dinged up (since the arrival time of most fallout lags behind the blast wave, there would be leeway to do this if you didn't dilly-dally around.) In areas very close to blast, you should also consider placing valves on the vents; these are available from some of the survival companies listed in the appendix of this book and Kearny's NUCLEAR WAR SURVIVAL SKILLS contains a workable—if crude looking—valve which will offer protection for excessive blast pressures.

When possible, "camouflage" your vents so that they won't be noticeable to casual observation. This can save you a lot of explaining and might keep you from being attacked by looters following a nuclear


DIRECTION OF ENTERING BLAST
16-PENNY NAILS (TYPICAL)
1½ in.
1½ in.
1 in.
2 in × 8 in (NOMINAL) FINISHED BOARDS
60°
1 in.
4½ in WORN-SMOOTH TIRE TREAD RUBBER
1½ in.
1½ in


8 in. DIA. POLES, FLATTENED ON TWO SIDES
12 in. BETWEEN POLES
TOP OF BLAST VALVE SHOULD BE AT LEAST 3 ft BELOW THE BLAST DOOR ON ENTRY
2 in.-THICK BOARD, A PART OF THE VERTICAL AIR DUCT, 19 X 10 in. IN FRONT OF THE VALVE
2 in.
8 in.
22 in.
18 in.
2 in.
1 X 12 in. OPENING
1⅛ in.
1⅛ in.
1 in.
BLOCK THIS OPENING WITH VERTICAL POLES
BRACE-BOARDS PRESSING AGAINST THE FACE OF THE VALVE HOUSING TO KEEP NEGATIVE PRESSURE FROM "SUCKING" OUT THE WHOLE VALVE
VERTICAL AIR DUCT SHOULD EXTEND 2 OR 3 ft BELOW BOTTOM OF BLAST VALVE AND PREFERABLY BELOW THE BOTTOM OF THE VERTICAL ENTRY

For those living close to a target, this blast valve developed by Kearny and other government workers can be created from worn rubber tires and wood. The leading edge of a blast wave would push the tire rubber shut and then be prevented from entering a shelter.

war.

As we have seen, the walls and the ceiling of a shelter must be dense enough to stop the radiation. This shielding gets pretty heavy so be sure everything is braced and supported properly so it won't cave in or fall over at a critical time. The shelter should be able to support some of the load of any near-by structure should it fall over or collapse onto the shelter.

There are two basic places for a shelter to be located. Outside your home (either above or below ground with the entrance from inside the house or from outside) and inside your home (usually in the basement). The basement shelter is more convenient to enter and takes advantage of the shielding properties of your house. Conversely, the in-house shelter would be a poor choice in a blast area or where your house might be blown apart or catch fire since you'd have to either dig your way out of it or become a crispy critter if worst came to worst.

Another important consideration is whether you need only a fallout shelter or a combination blast and fallout shelter. The blast shelter must be considerably more reinforced with steel rebar, etc., and will generally be more expensive to construct. (The exception to the expense of blast shelters is Kearny's "expedient shelters" outlined below. Such a shelter is capable of flexing with a blast and therefore needs little in the way of expensive materials to offer a lot of protection from a blast wave.)

Before you start excavating for a shelter, you should also do some checking to be sure that the water table is not close to the surface of the ground. In some areas of the country (Texas and Florida especially), it is nearly impossible to make a below-grade structure without having it fill with water. Above grade shelters will require more work and expense because shielding material must be built up around them.

A shelter comprised of a number of small rooms will be more resistant to damage than one consisting of one large room. Small rooms will also offer some semblance of privacy to the shelter occupants.

Whatever type of shelter you make, be sure it is placed so that it can be conveniently used in a hurry. If it's hard to get to, you may not have time to use it. It is also wise to have a doorway which does not require having to crawl or bend excessively to enter the shelter; such doors allow the shelter to be used quickly and also make it easier to keep the shelter stocked and clean when it is not being used.

The entrance door to your shelter should be carefully chosen. It should be heavy and ideally would seal air-tight. Two doors—with an inner and outer door and several right-angle between them—are better than one. Double doors will minimize radiation inside the shelter and cut down on the air pressure inside your shelter when it is struck by a blast wave. If you are in an area where blast may be a consideration, be sure that the doors are secured against both the blast and the suction wave; one pushes inward while the other will try to pull the door outward.

In addition to the main entrance, an emergency exit for a shelter is a good idea. Such an exit could merely be a man-sized tube which ends in a door slightly below ground level (so that it can only be located from inside the shelter). The emergency exit can be filled with sand or supplies to cut down on the radiation which can enter the shelter through the second doorway.

Both the main entrance and any emergency exits should not enter straight into the shelter. They should connect to the shelter with some short, winding halls so that radiation will not have a direct route through the door and into the shelter.

If you can afford the extra expense, a gravity-powered shower should be placed in the hall between the two shelter doors so that someone who enters after being outside in a contaminated environment can wash down before entering the shelter. The drain to this shower should exit through drainage other than the city sewer system.

There are several different "grades" of shelter which vary according to their initial cost. Probably the least expensive is the "expedient shelter" which can be improvised "on the spot" and need not cost a lot of money. The best examples of such shelters are those designed by Cresson H. Kearny. These shelters are made of wood, doors, plastic sheets, good old dirt coupled with lots of hard physical labor. A number of good expedient shelters have been designed and tested (with mounds of TNT) at the Oak Ridge National Laboratory under the direction of Kearny. The only drawbacks with such shelters are that they are temporary and it takes a lot of time and brute strength to create one. Nevertheless, if you were trapped away from home or lack the money to build a better shelter, then these shelters are useful alternatives.

The plans for these shelters are available in Kearny's NUCLEAR WAR SURVIVAL SKILLS available from a number of mail order book stores including Loompanics Unlimited.

Should you happen to be away from home when nuclear war breaks out, you could use the expedient shelter to survive or—if time were limited—you could probably survive in a deep basement (where you can take advantage of density shielding) or a tall building (which allows you to take advantage of geometric shielding). You could even survive in a dugout with an overhang on it—just so long as you were careful to keep the fallout brushed away from the entrance. Your shelter doesn't have to win any HOUSE BEAUTIFUL awards; all it needs to do is give you adequate protection.

The next step up on the "shelter scale" is a permanent fallout shelter. Again, the only concerns are that the shelter be near by and that it will give you protection; "looks" don't count. Such shelters can be made of brick, concrete, etc., and will usually be buried in the earth to allow for additional shielding from the dirt. Keep in mind, too, that if you're in an area which is not close to prime targets and it appears that you won't be having to spend a lot of time in a shelter, then it might make sense to just have a small and simple shelter. Such a shelter can be constructed with very little money and—though cramped—would get you through the dangerous period when fallout is covering your area.

When you have figured out how big your shelter needs to be and how thick your shielding requirements are, use a little "creative thinking" to save money in expenses. Good shelters have been made from old metal storage tanks which were buried in the earth, large precast concrete slabs (to form the roof—it could have dirt walls!), and large corrugated metal forms normally used for culverts.

When improvising a shelter, remember that flexible materials make better blast shelters than many other materials since they give with a blast wave and then spring back into place rather than cracking or breaking. Curved walls or ceilings are also stronger than flat spans.

A number of basement shelters were designed during the 1950's and 1960's by the US Civil Defense. Many of these show heavy loads of bricks being placed between rafters of the house with a plywood sheet nailed in place to hold the heavy material up. Some of these shelter plans can be quite dangerous or will cause the floors of the house to sage under the weight as time passes. Even if the floors are reinforced to hold the extra weight, any sort of blast stress placed on the house might alter things radically. In such a case, the whole shelter ceiling might cave in on its occupants.

For this reason, whenever possible, it's a good idea to have an in-house shelter capable of supporting its ceiling regardless of damage done to the house it is in.

Strong shelters can be created with cement "cinder blocks" and reinforced cement. New fiberglass/cement surface bonding material allows you to quickly join the blocks together with a bonding that's stronger than cement mortar. Thus, to build the walls of a shelter, the blocks are just stacked—dry—in the form of your wall and after you check to be sure everything is plumb, you coat the surface of one side with the fiberglass/cement coat. Once the coat dries, the wall is more solid than standard mortar and cinder block walls. The fiberglass/cement mixture is sold under the trade name of "Quickwall" and can be purchased (or ordered) through any lumber/construction supply store.

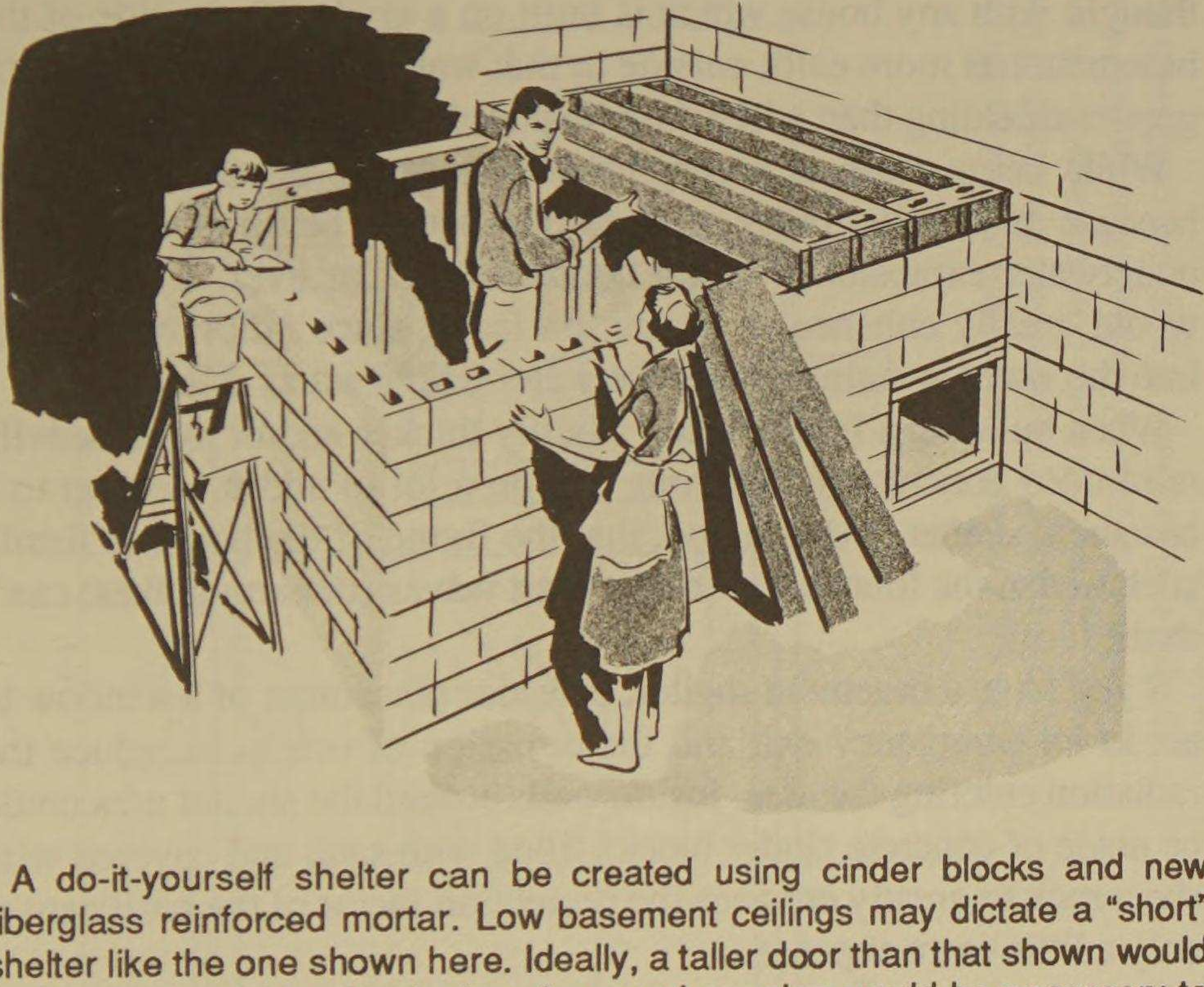
Once the "Quickwall" blocks are joined, rebar can be placed in some of the hollow block cores and filled with cement to create internal columns to hold up the roof of a shelter. Other hollow cores of cinder blocks in the wall could be filled with dirt or sand to increase their density shielding for a very small expenditure. This type of arrangement allows the home owner to "cast" the walls for his do-it-yourself shelter without any expensive forms and also allows "cheap dirt" to be incorporated into it to save money while still achieving a high level of protection.

The roof on such a shelter can be created by pouring it directly onto a form with rebar positioned before hand to strengthen it. While the roof of the shelter will need support until the concrete in it cures, the job is still capable of being done in a do-it-yourself manner in a house basement that has already been constructed without a shelter.

If you're planning on doing any cement or masonry work yourself, one useful book to get is CONCRETE, MASONRY, AND BRICK WORK which was written by the US Department of the Army and is quite easy to understand. (Copies of this are available from Dover Books for $5.95.)

Though I've never seen it done, I suspect that a fairly inexpensive shelter could be created by using sand bags to form the walls of a shelter. If care were taken, it might even be possible to create a tapered wall that gradually formed the roof like an igloo (but be sure you know what you're doing if you try that or you'll create a very dangerous situation). Such a shelter would need to have two layers of bags to soak up radiation which might otherwise stream through holes between bags. The whole shelter would also need to be covered with a heavy plastic tarp to keep fallout dust from drifting into it.

A sand bag shelter would also offer the option of removing the



A do-it-yourself shelter can be created using cinder blocks and new fiberglass reinforced mortar. Low basement ceilings may dictate a "short" shelter like the one shown here. Ideally, a taller door than that shown would be incorporated into the design. A second opening would be necessary to provide adequate ventilation.

shelter at a later date if the original home owner moved or created a better shelter elsewhere on his property. A number of military surplus companies sell woven plastic sand bags which can be filled with dirt or gravel as well as sand. (One good source is Phoenix Systems, Inc., which sells bags for .95 cents each in groups of 101 or more.)

If you're building a house or upgrading an old one, there is a lot that can be done to improve its potential to increase your basement shelter's protection from fallout radiation. The building's location on a site is quite important. If the topography of the area slopes, siting a house so that the land slopes away from it will reduce the amount of radiation it would receive from the ground. Earth berms, terracing, or other landscaping can also be used to minimize the exposure of the house to radiation from the ground. Since dirt is free and the landscaping will increase the home's value, such work can give you several benefits at once.

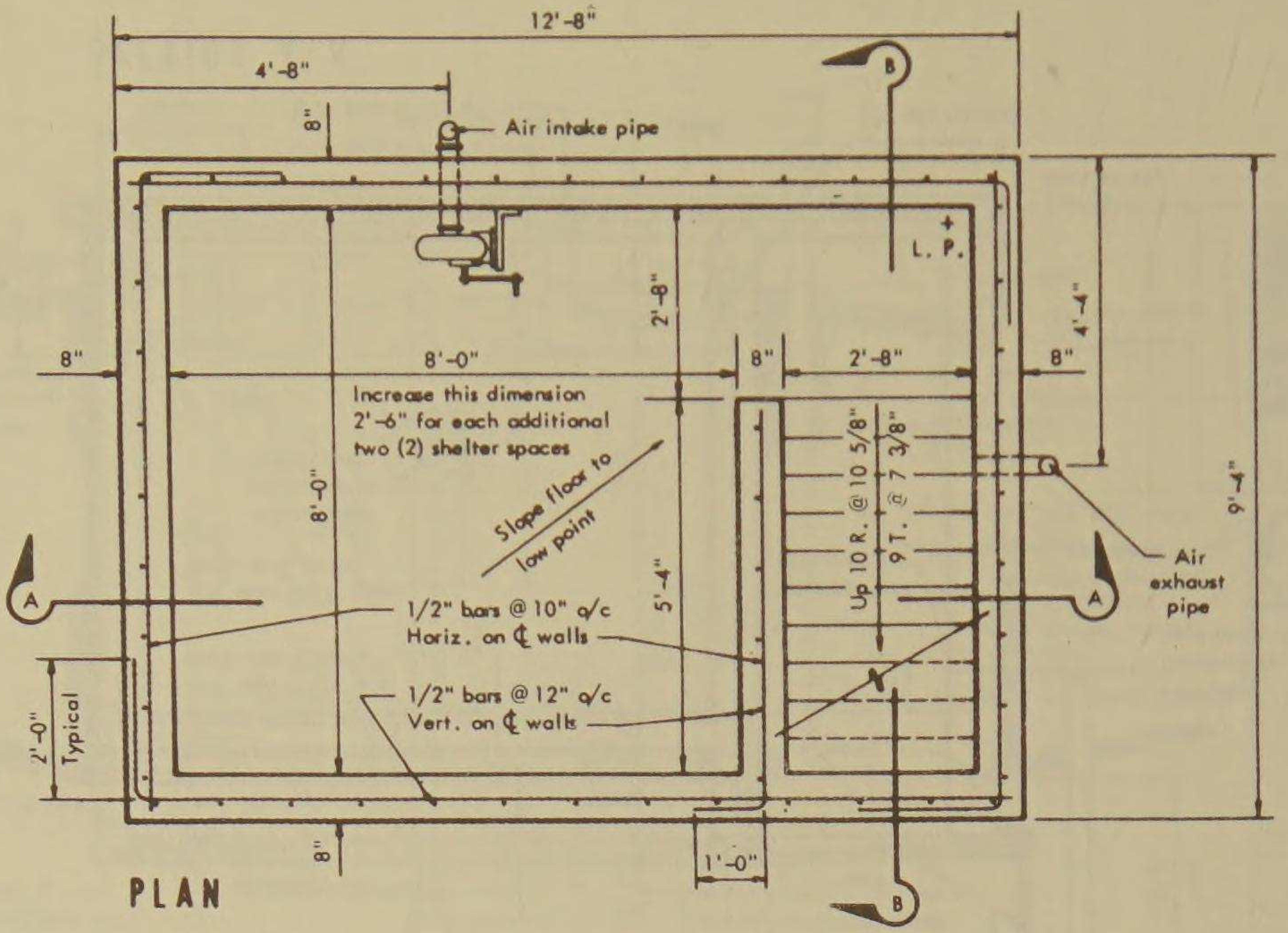
Placement of the basement shelter itself should be given special thought with any house which is built on a grade. If one side of the basement has more earth outside it, that wall will usually give much greater shielding than will a more exposed side of the basement.

While being close to a very large lake or the ocean is not ideal because of the possibility of large tidal waves being created by an underwater explosion, siting a house next to, or over, a small lake would greatly enhance its protection factor since fallout would fall into the water and sink so that the water would act as shielding.

When building a house, using slightly thicker and/or more heavily reinforced concrete foundations will do a lot to add protection to a basement shelter. Be sure, too, that the frame of the house is firmly anchored to the foundation so that blast waves (or earthquakes) can't shake it off.

If you have a basement shelter, consider placement of a window to act as an emergency exit and the omission of others to reduce the radiation entering the area. Inside walls around the shelter area could be made of concrete cinder blocks filled with sand and covered with sheet rock to greatly enhance the protection factor of the basement at only a little extra expense.

If you're having a house built, when practical, use a number of



PLAN

12'-8"
4'-8"
8"
Air intake pipe
B
L. P.
2'-8"
4'-4"
8"
8'-0"
8"
2'-8"
8"
Increase this dimension 2'-6" for each additional two (2) shelter spaces
Slope floor to low point
8'-0"
Up 10 R. @ 10 5/8"
9 T. @ 7 3/8"
9'-4"
A
5'-4"
A
Air exhaust pipe
1/2" bars @ 10" o/c Horiz. on ℄ walls
1/2" bars @ 12" o/c Vert. on ℄ walls
2'-0" Typical
8"
1'-0"
B

NOTES

Exterior walls, roof slab and under floor slab shall be waterproofed with a 3 ply membrane waterproofing system. This provides a continuous blanket which seals the entire area of surface to be protected. The membrane shall be protected from back fill damage and when completing other stages of construction.

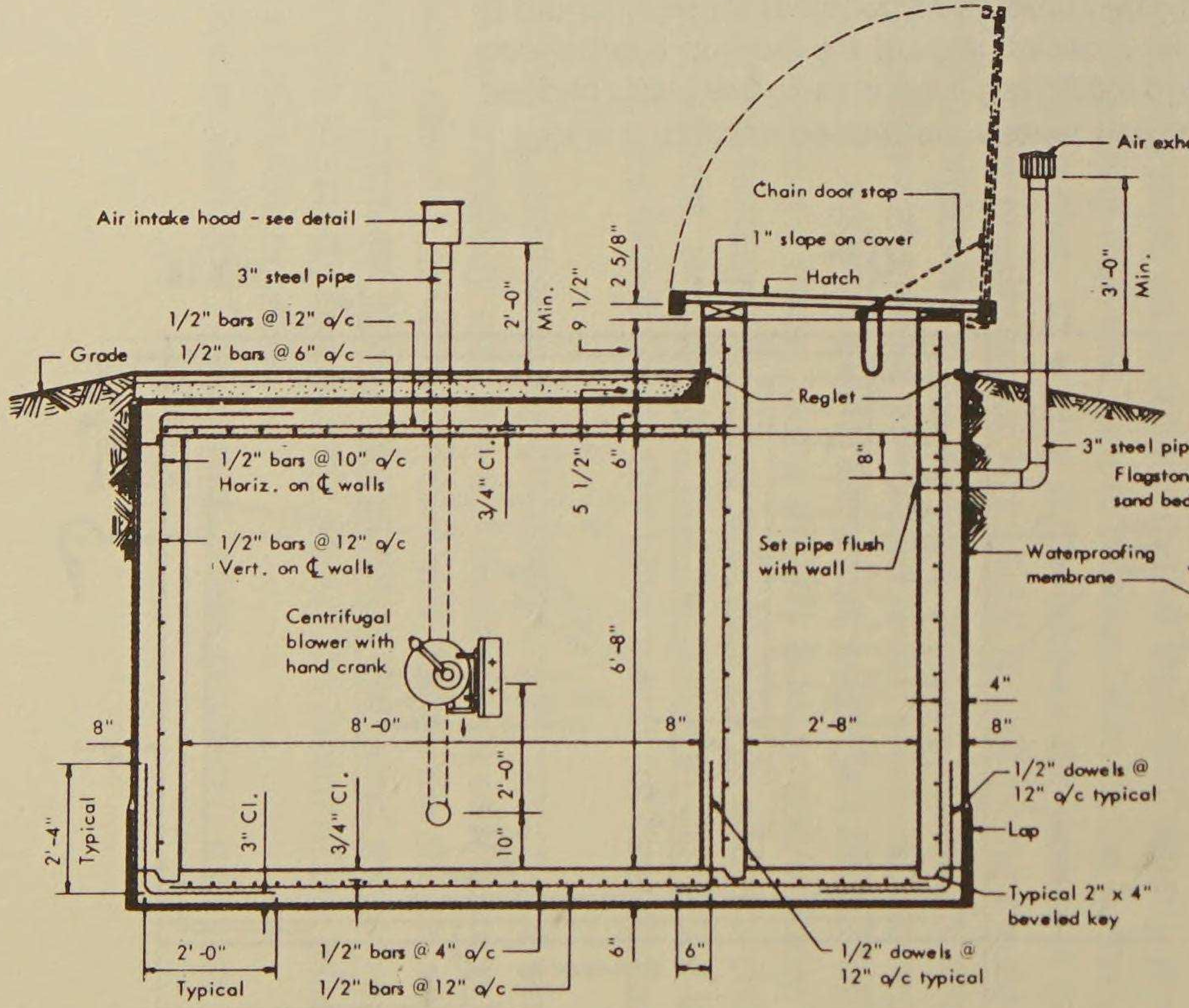
Place flagstone or bricks on a sand bed when using the roof slab as a patio.

There are a number of commercially produced metal roof hatches that will adequately serve as a shelter door. However, as long as the door is weatherproof and durable, a job-made, galvanized sheet metal covered wood door is suitable.

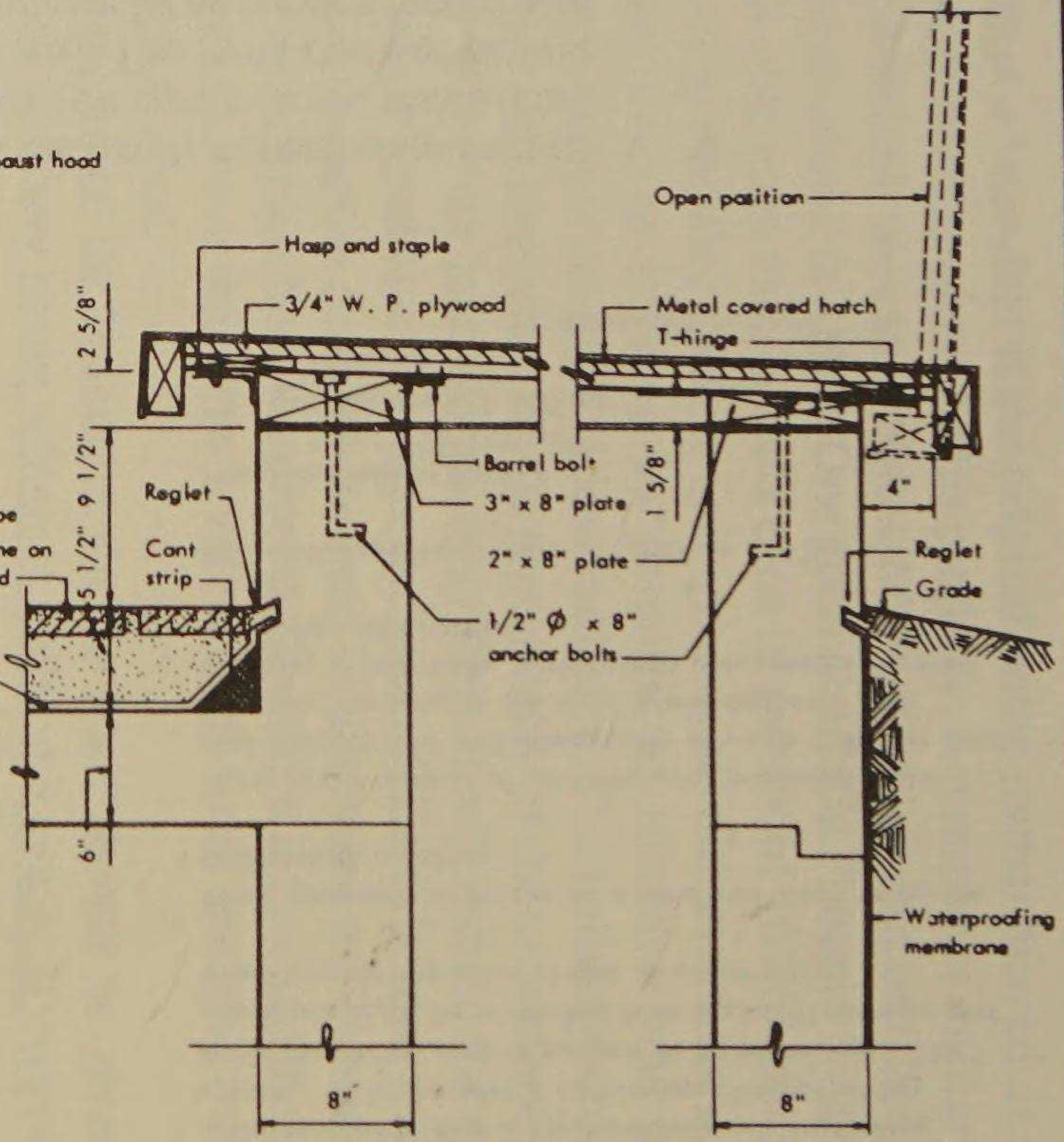
Bevel all exposed corners of concrete 3/4" at 45°

Structural design data:
Steel = 20,000 psi
Concrete = 2,500 psi
Soil (minimum) = 600 psf, to withstand downward pressure

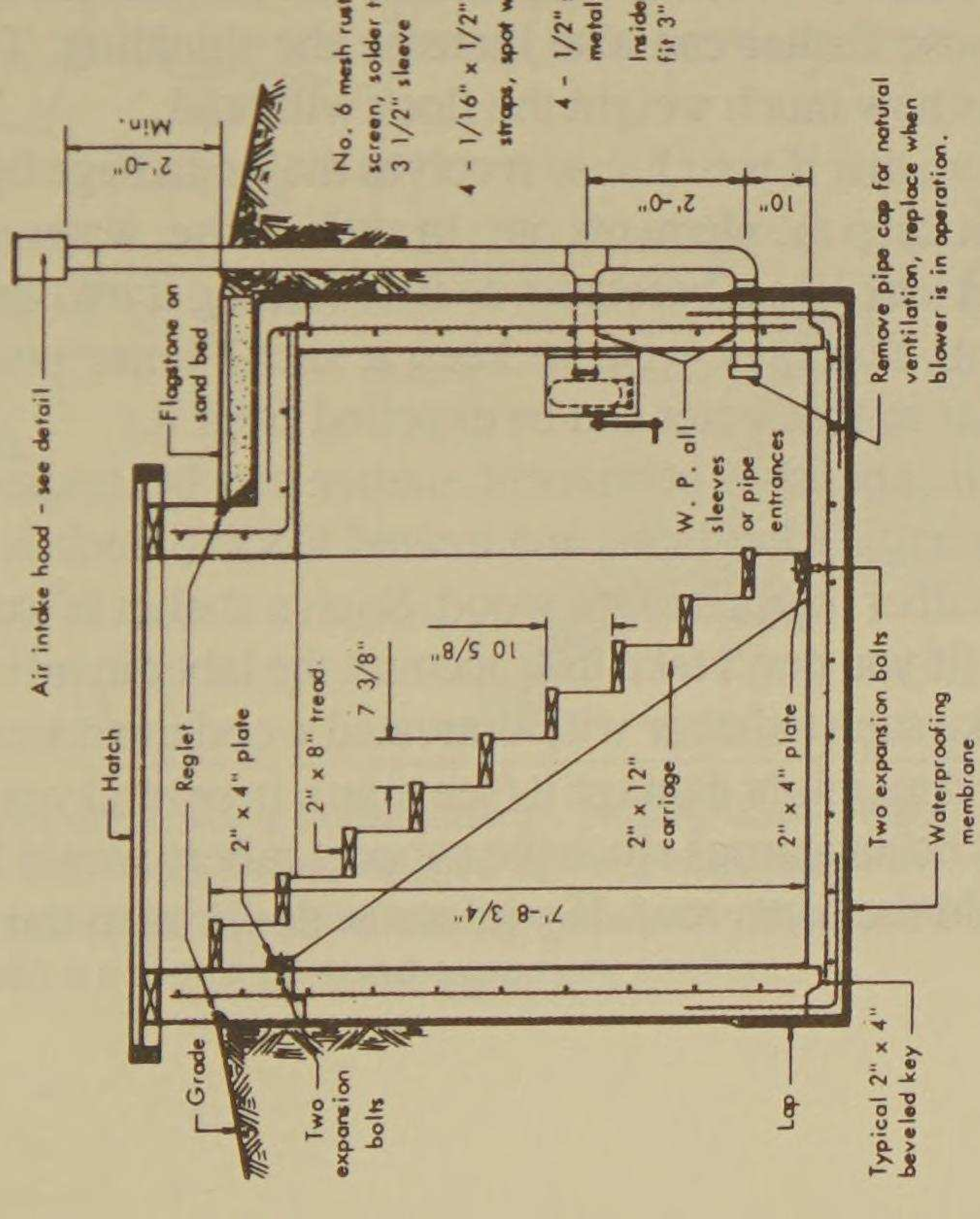
This is a minimal permanent shelter which will barely accomodate several people. However, by extending the length of this design, it can be made more comfortable and have a greater capacity as well. The hand-cranked blower is probably better replaced by a Kearny Air Pump or by air fanning techniques using a a large piece of plywood, cardboard or even a blanket held between two people.


Air intake hood - see detail
3" steel pipe
1/2" bars @ 12" o/c
1/2" bars @ 6" o/c
Grade
2'-0"
Min.
9 1/2"
2 5/8"
Chain door stop
1" slope on cover
Hatch
Air exhaust hood
3'-0"
Min.
Reglet
3" steel pipe
1/2" bars @ 10" o/c
Horiz. on ℄ walls
1/2" bars @ 12" o/c
Vert. on ℄ walls
3/4" Cl.
5 1/2"
6"
8"
Set pipe flush
with wall
Waterproofing
membrane
Centrifugal
blower with
hand crank
6'-8"
4"
8"
8'-0"
8"
2'-8"
8"
1/2" dowels @
12" o/c typical
Lap
2'-4"
Typical
3" Cl.
3/4" Cl.
2'-0"
10"
Typical 2" x 4"
beveled key
2'-0"
Typical
1/2" bars @ 4" o/c
1/2" bars @ 12" o/c
6"
6"
1/2" dowels @
12" o/c typical

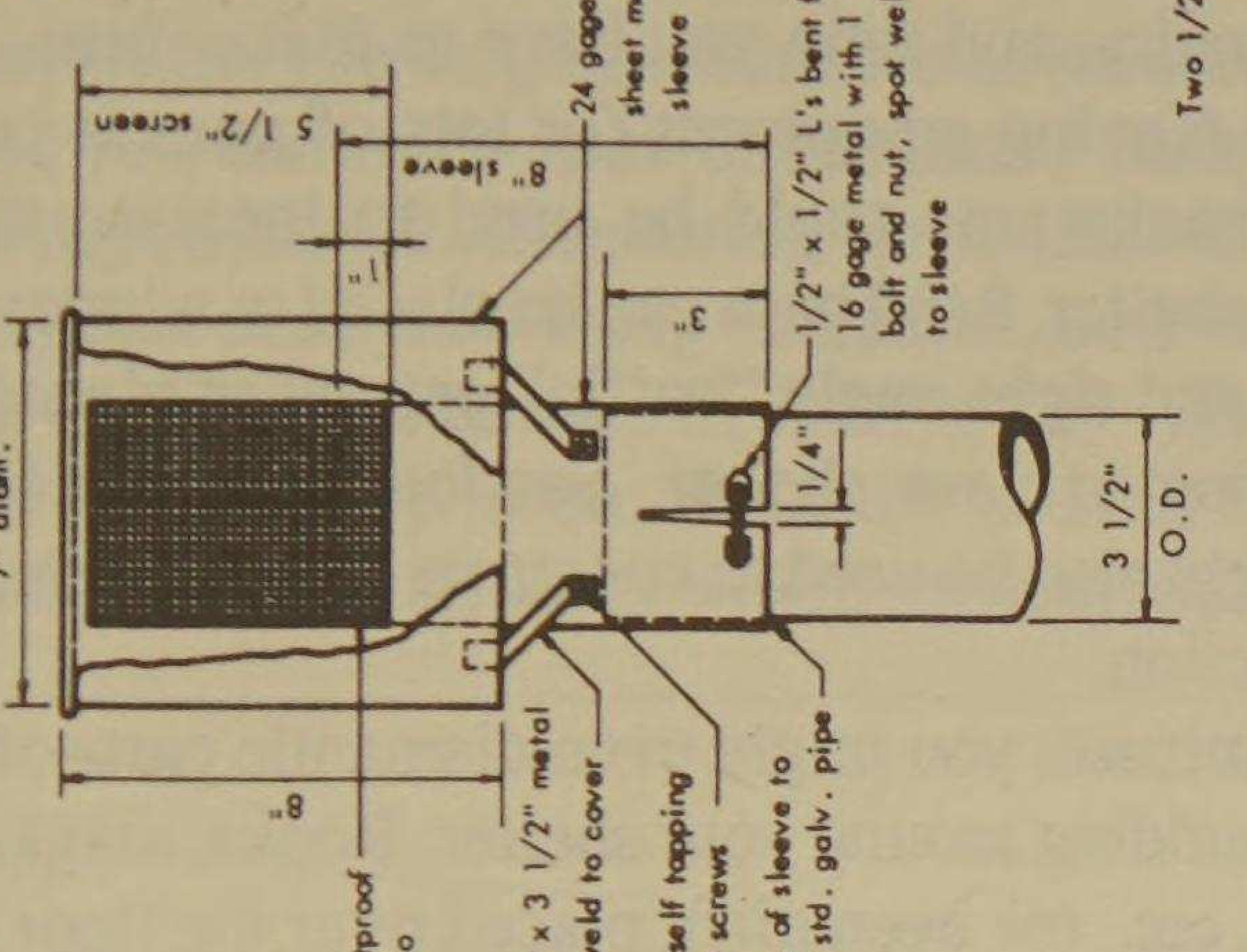
SECTION A-A


Open position
Hasp and staple
3/4" W. P. plywood
Metal covered hatch
T-hinge
2 5/8"
9 1/2"
5 1/2"
Reglet
Cont
strip
Flagstone on
sand bed
Waterproofing
membrane
Barrel bolt
3" x 8" plate
2" x 8" plate
1/2" Ø x 8"
anchor bolts
1 5/8"
4"
Reglet
Grade
6"
Waterproofing
membrane
8"
8"

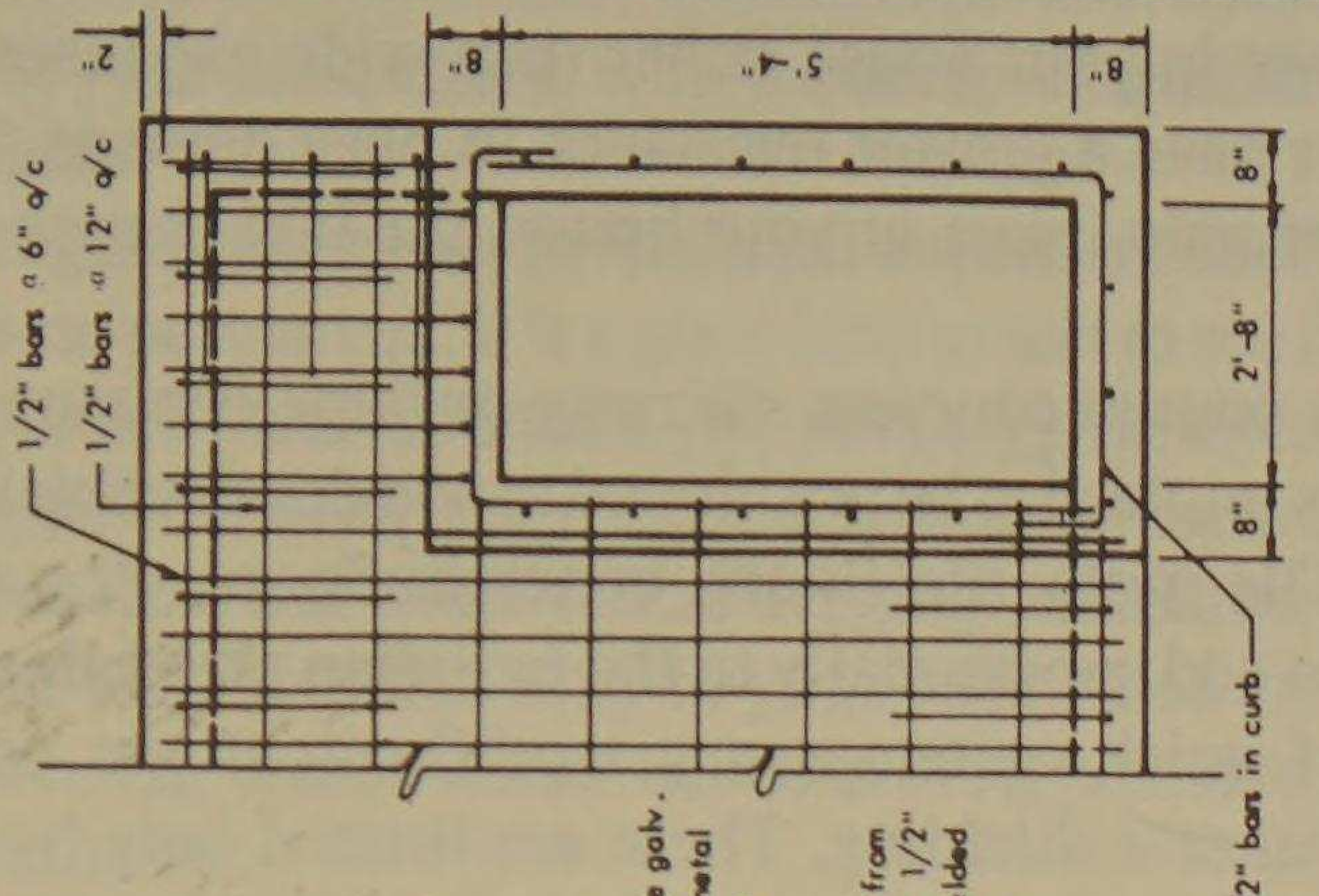
HATCH DETAIL


Air intake hood - see detail
Hatch
Reglet
Flagstone on sand bed
2'-0" Min.
2'-0"
10"
2" x 4" plate
2" x 8" tread
7 3/8"
10 5/8"
2" x 12" carriage
2" x 4" plate
W. P. all sleeves or pipe entrances
Remove pipe cap for natural ventilation, replace when blower is in operation.
7'-8 3/4"
Two expansion bolts
Waterproofing membrane
Grade
Two expansion bolts
Lap
Typical 2" x 4" beveled key

SECTION B-B


7" diam.
5 1/2" screen
8" sleeve
1"
3"
8"
24 gage galv. sheet metal sleeve
1/2" x 1/2" L's bent from 16 gage metal with 1 1/2" bolt and nut, spot welded to sleeve
1/4"
3 1/2" O.D.
No. 6 mesh rustproof screen, solder to 3 1/2" sleeve
4 - 1/16" x 1/2" x 3 1/2" metal straps, spot weld to cover
4 - 1/2" self tapping metal screws
Inside of sleeve to fit 3" std. galv. pipe

AIR INTAKE HOOD DETAIL


1/2" bars @ 6" o/c
1/2" bars @ 12" o/c
2"
8"
5'-4"
8"
8"
2'-8"
8"
Two 1/2" bars in curb

HATCH FRAMING

smaller windows in your house rather than wide expanses of glass. Small windows have a greater resistance to blast damage. The more windows that remain intact in your house, the less chance of fallout entering it.

If you have a poured concrete stairway or large concrete porch on your house, this might also be positioned to add density shielding over your shelter. Tile roofs, tile floors, concrete floors, etc., above the shelter will also add substantially to the radiation protection.

A number of quick or temporary modifications are possible to increase the shelter's shielding. These are limited only by your imagination, ingenuity, and time you have to make them. If you have access to earth-moving equipment (or lots of muscle power), earth berms and embankments could be used to increase the shielding outside of your shelter. Sand bags can be placed in windows or unused door openings and right-angle "baffle" entrances placed in front of doorways leading to your shelter. Sandbags, cinder blocks, loose bricks, etc., might also be used to construct low walls that would add to shelter protection.

If war were eminent, you might even dismantle parts of your house and use it for shielding around your shelter. Books, magazines, heavy furniture, tools, etc., (or even dirt), placed over the floor on the level above an in-house shelter can also increase the shielding. The only consideration is how much weight the floor will hold.

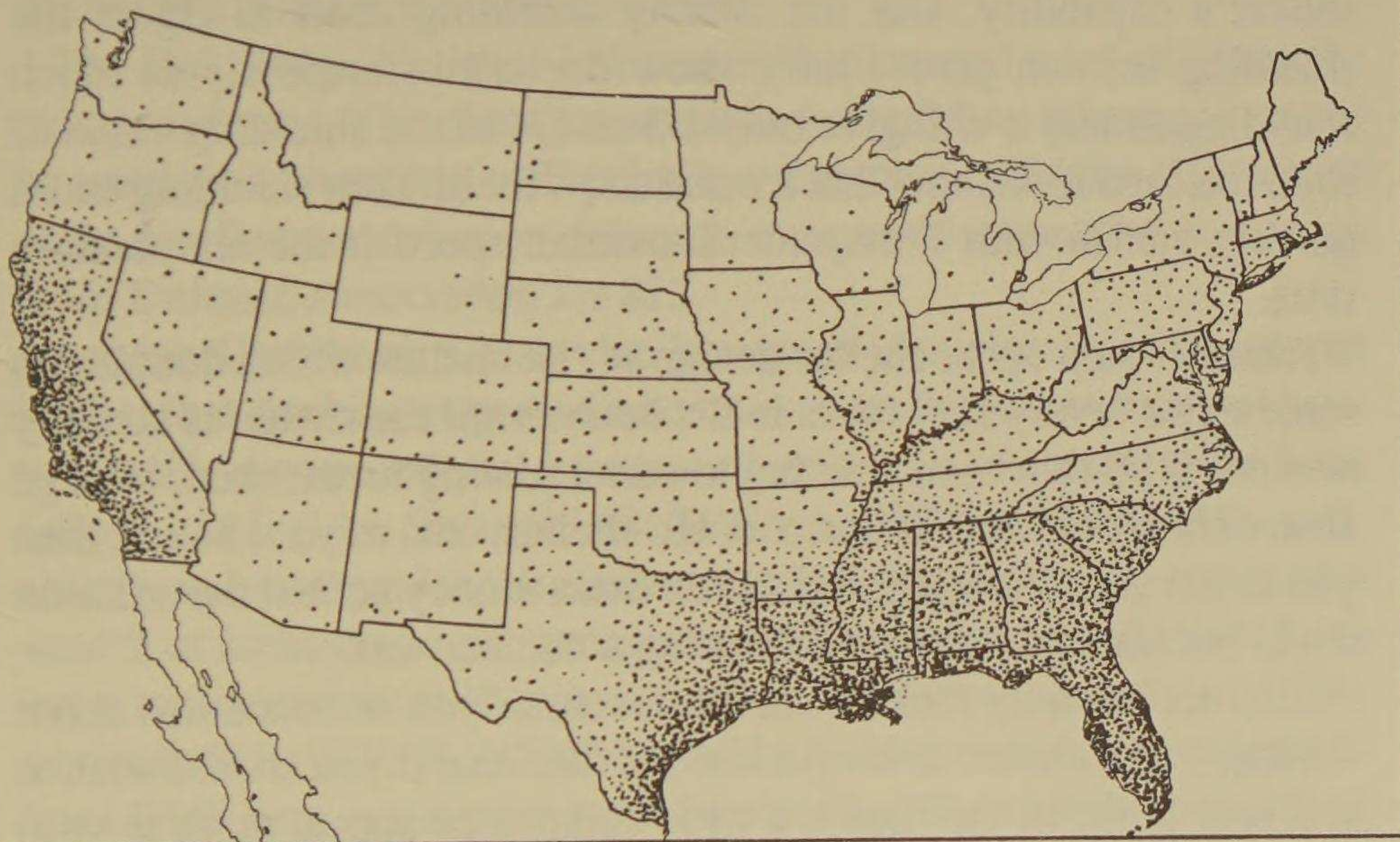
Remember, too, that if your house receives major damage by a blast wave it may not keep the elements out. In such a case, water entering the house could leak into a basement shelter turning it into an indoor swimming pool. You may wish to keep a small water pump in a basement shelter so that water can be expelled from it.

A relatively inexpensive permanent shelter can be created using Kearny's expedient shelter plans and treated wood (which is termite and rot proof) rather than standard wood. Such a shelter is extremely cheap to make (if you don't take into account the labor involved). Do NOT try to make such a shelter with untreated wood in an area where termites or wood rot might damage it (see map). In several years, such a shelter would be dangerous since the support rafters would become too weak to hold the earth roof. If you are in doubt as to the termite activity in your area, check with a county extension agent for more information.

When digging either a conventional expedient shelter or one which will become permanent, it's a good idea to test to see if the earth walls will support themselves before you start digging too deep. If the walls won't support themselves, you'll need to shore them up so the shelter won't cave in. (And when you're digging, remember that you can be suffocated even if buried only to your neck since the earth will keep you from being able to inhale because of its pressure pushing against your chest.)

Test the earth after you've gone 18 inches down into it. The test itself is simple: if you can stick your thumb more than 1 inch into undisturbed soil, you should start shoring up the sides of the hole. Repeat the test every foot after you've dug 36 inches. Don't create overhangs or try to dig unsupported tunnels in earth of any type.

Shoring is rather tricky to do. Basically it done by creating overlapping flat boards or small sticks which are held in place with support



Termites can quickly undermine an underground shelter's wooden support beams. This map shows relative termite hazards in the U.S. Areas where termite activity is high dictate using metal, concrete and/or stone for anything other than a soon-to-be-used expedient shelter.

frames. As you dig, care must be taken not to disturb the framing material and to overlap both the walling boards and framing. Remember that failure to properly use enough shoring could spell your death; don't skimp.

When digging, use both a pick and a shovel. Use the pick to break up the earth and the shovel to scoop it out. If you try to break up and scoop with just the shovel, the work is harder and will go much more slowly.

Shelters built outside the house should not be built under trees or in brush. Trees tend to hold radioactive fallout in their leaves and bark so that the radiation level will be noticeably higher under a large tree.

Be sure that fallout can not seep into the shelter's walls or be washed into the shelter by rain or melted snow. Water can also wash the dirt shielding away. One way to prevent water from eroding the soil is to place plastic sheets over the dirt (with several inches of earth over the sheets to keep them in place and allow plants to grow over the earth). Ideally this plastic should be at least 4 mils. thick.

Ice and snow can be used for shielding and can greatly augment a shelter's capability. Use the density shielding chart to figure the shielding ice can give. Fluffy snow doesn't offer nearly as much shielding as ice; it will give only 1/3 or 1/4 of the shielding value of solid ice. And remember that ice and snow melt! Your shielding could quickly vanish with Frosty the Snowman speed if the temperature rises.

The next step up in shelter design is the shelter which doubles as some other "everyday" room in the house until the shelter is actually needed. If you've been wanting to add a sewing room, shop, storage area, dark room, wine cellar, tornado shelter, etc., to your house, then you might consider spending a little extra money so that the addition could become a fallout shelter during a nuclear war.

Such double-duty shelters are also useful if you're concerned about "hiding" your shelter to keep a low profile. And if you should wish to sell your home in the future, a wine cellar may appeal more to your prospective buyers than would a fallout shelter which they may feel they don't need.

The "ultimate shelter" can be created in the form of a carefully thought-out earth-sheltered residence. Such houses already have a lot going for them since many are attractive, energy efficient, and cut out a lot of the outside noise that plagues today's society. The catch is that the houses are more expensive to build than conventional houses (though they are cheaper to own in the long run since they cut down on energy costs). During a nuclear war, if a little extra thought has been put into the house's design, it would afford a great amount of protection both from fallout and even from the actual blast of a nuclear bomb.

If you're planning on building a house, consider getting an earth-sheltered home. It should have the following essential features for maximum protection from nuclear war: a cast-in-place concrete roof (rather than a prefabricated concrete plank roof), a depth of at least 3 feet of earth over the top of the house, as much earth berming as possible around the sides of the house, and cast concrete walls throughout the house rather than hollow-block walls. The extra cost of these modifications to the design will increase the total cost by about 7 percent; the benefits include a stronger, safer house and a huge shelter if a nuclear war should occur.

The Oak Ridge National Laboratory has created a set of plans for one such house. The plans are suitable for building a house or could be used as a "jumping off" point by your own architect. The set of eight detailed construction drawings is available from the American Civil Defense Association for $25.

An excellent book which also has good ideas for creating a large shelter that doubles as part of a home—as well as some ideas on how to modify a conventional house so that it will give protection from fallout—is Joel M. Skousen's SURVIVAL HOME MANUAL available from Loompanics, Unlimited for $15. The book also contains a wealth of ideas on power-generating equipment, survival tools, finding a new location to live in, etc. (One important note: some of the advice in SURVIVAL HOME MANUAL about protecting equipment from EMP does not appear to be "workable." Be a bit more cautious than Skousen recommends in his book when it comes to EMP.)

Whichever route you take in building a shelter, BE SURE that what you build or are having built is safe. If you're not sure, check with someone that really knows. Building a dangerous shelter that might collapse is wasted effort at best.

Once the shelter is built, it would seem to be wise to keep a low profile. Ideally, no one would even know that you have a shelter. An old TWILIGHT ZONE segment is a "must see" for anyone who owns or is about to build a shelter. In the story, a group of neighborhood friends are listening to the radio during a birthday party. Suddenly the musical program is interrupted and over the radio comes the news that a nuclear war is imminent.

The hero of the story asks everyone to leave after reminding them of how often he'd warned them to prepare as he had. Everyone goes home and the hero and his family retreat into the shelter.

Things progress in a very logical, if chaotic, manner for the next fifteen minutes of the show until finally the hero's best friends and neighbors have rationalized that they should be in the shelter instead of the hero and his family. Near the finish of the story, the neighbors break down the shelter door in a frenzy of mob violence.

The shelter owner tries to reason with those outside to convince them that there is neither the room or the supplies for everyone to survive. Unfortunately the show winds down with a rather contrived ending—the war alert was a false alarm—and Rod Serling assures us all that this is only happening in the TWILIGHT ZONE and we're dumped into the next commercial.

Nevertheless, the show is like a sermon to those who have a shelter. The message is simple: if you don't want to have to forcibly protect your family's rights to stay in your shelter, keep your preparations as secret as possible.

You can't save everyone when the warheads start to arrive. If you have people breaking down the doors to one small shelter, no one is going to survive. You ARE responsible for those you construct your shelter for. You are NOT responsible for your neighbors nor can you make your neighbors create their own shelters. The fact that nuclear weapons exist is public knowledge. Your neighbors could purchase this book (or others like it) just as easily as you and they can make—and are responsible for making—plans for their own survival. If they choose not to make plans to survive, they have no right to ruin your chances for survival should a war actually come to pass.

(Remember Noah and the ark. Everyone thought Noah was crazy until it started raining. Then everyone felt he should let them on board. God sealed the door of the first shelter—the ark—when the crowds decided that Noah needed to help them survive... In the end, Noah and his family survived while those who hadn't prepared perished.)

Everyone knows that a nuclear war is possible. Everyone is making a choice as to whether to survive if the worst comes to pass or to spend their money on luxuries and hope for the best. You probably have little more money than your neighbors do; you can't support them while they spend their money on luxuries and gamble that the worst will never happen to them.

Hopefully the worst will never occur. But if it does, those who gamble with their lives will have to pay their own debts; your family should not pay for them. You should help those who may survive; plan on bartering or whatever. But trying to help those who'll die in the long run will only cause you to make it impossible for your family to survive.

(For much the same reason, some thought should be given as to how the shelter could be defended against looters. A small gun port alongside the door or the like may seem strange to think about now but might be a lifesaver in an actual emergency when you might face looters after fallout levels sink to lower levels. More on self-protection later.)

A shelter will do you little good if you need to stay in it for any time and haven't stocked it or made plans for dealing with waste. In a space as small as a shelter, it would be very easy to quickly get up to your armpits in junk. Too, small spaces can give those living in them cabin fever; a lot of thought should be given to how to "entertain the troops" and take up time in order to prevent everybody from cutting each other's throats.

Don't make your shelter into a place that you wouldn't chain a terrorist in; a shelter that looks bad, is poorly lit, or damp will do little to build morale. In an emergency, morale can make the difference between survival and dying. A coat of paint and a little extra money spent here and there can make your shelter much more pleasant to be in and may be just as important to your survival planning as your shelter walls.

Sleeping gear such as hammocks, cots, bedding, or sleeping bags should also be considered both for the stay in the shelter as well as possibly afterward (though it is also possible that you'll be able to clean up your house and live in it when the worst is over). For use in a shelter, my first choice in sleeping pads are the military surplus "thinsulate" sleeping pads available from Sierra Supply for just $10. Chairs and tables are optional with folding furniture being most ideal. Storage containers containing food and gear can serve duel purposes in a shelter. Use large boxes for tables, chairs, or—grouped together—for beds. Small cushions can transform these into relatively comfortable furniture and help you to not waste space; a table top—without the legs—placed on storage boxes can transform them into a viable table. When not in use, the table can be leaned against the wall to create more space.

Light is important for maintaining your morale and—during the first days of the crisis—a small light may be needed even when everyone's asleep.

Of course AC-powered lights aren't an option since utilities will be the first thing to go during a nuclear war. Gasoline generators, solar panels, etc., will also be quite useless when you're trapped in a shelter and a burst of EMP might burn out generating equipment if you were able to get it up and running.

While electric lights run on batteries or a hand-cranked generator can be of use for short periods, they are probably best saved for occasional use only. A fully-charged auto battery and 12-volt lights might supply several hours or even days but would finally run down.

Gas or kerosene lamps do give off light but are fire hazards, need a lot of fuel for extended use, and can create dangerous levels of carbon monoxide. They are NOT ideal for a shelter.

What's left? Candles. They give off a lot of light with a minimum of carbon monoxide (if kept near the exhaust vent); they usually extinguish themselves if tipped over and they burn slowly so that a long period of lighting can be purchased and stored for very little money. Placing foil behind a candle will help focus and increase its light and several can be lit at once to increase the light for reading while just one candle can be used for a night light.

Tapers generally burn more reliably than large candles which often have wicks that don't burn the wax quickly enough; the liquid wax of large candles often extinguishes the candle wick after it's been used for a couple of hours. You can create a larger wick with a piece of twisted Kleenex, match, etc., or pour out excess wax—but small tapers are a better bet.

Though perhaps more ideal for use AFTER leaving a fallout shelter, it's also possible to construct lamps which burn animal fat or vegetable oil. Use heavy twine or string (no plastics) for the wick. Remove the wick or squeeze it dry after the lamp has been out for a while and you're ready to restart it.

In a shelter, getting rid of trash and garbage correctly is essential. Use empty cans of supplies to store garbage in. The lid can go back on a can full of garbage and be sealed shut with masking tape or duct tape. Plastic bags are also good for sacking up trash but be sure that garbage of the odor-producing kind doesn't go into plastic bags—smells will be leaking out to attract varmints and, if the sack is accidentally ruptured, it could create a disastrous mess.

When radiation sinks to levels which allow you to leave your shelter for short periods, one of your first tasks is to take garbage out and bury it (no, you don't get away from taking out the garbage even after a nuclear war!). Bury garbage downhill from your well or other water source so that you don't contaminate it. You can't just throw any trash out. It may give away your position if you're trying to stay hidden from looters or the like. Garbage must be buried to keep down the number of pests since rodents and insects (ants, flies, gnats, cockroaches, etc.) have a high resistance to radiation.

Poor toilet facilities will quickly end your will to survive; your "rest room" can be crude but it must work efficiently. Your toilet may be a pail, bucket, or a portable chemical toilet. (Toilet facilities and sewage systems will be covered in lurid detail in a subsequent chapter.)

A shower curtain or privacy screening of some type is another important consideration for the toilet area. Placing the toilet by the exhaust vent of the shelter is also a good idea since this will minimize the odors in the shelter. This is important, too, with chemical toilets; while they are supposed to be odorless, they aren't.

If you (or anyone in your shelter) smokes, going "cold turkey" during your shelter stay should be considered since there won't be many cigarettes being manufactured for some time. If you must smoke, do so next to the exhaust vent so that smoke and carbon monoxide won't remain in the shelter. Since tea and coffee will also be very hard to come by following a nuclear war, you would do well to learn to do without these beverages as well.

Each shelter member should have a small kit of Kleenex, toothbrush, silverware, "barf bag," small garbage sack, etc., so that a minimum of germs will be spread among shelter occupants. Don't allow children (or children over 20) to get sloppy. Neatness will help keep you from becoming sloppy in your outlook and thinking while cooped up in the shelter.

Humidity may create problems in a shelter. The humidity can be lowered by increasing the air flow through your shelter. Even with increased air flow, humidity may become great enough to damage moisture-sensitive equipment. Air-tight metal or plastic containers should be used for storing sensitive equipment and hydrosorbent drying packets can go into containers of especially sensitive items. Be careful, too, to keep metal containers and large cans off flat surfaces since moisture may condense under them and create rust or corrosion; to prevent this, place spacers under the containers so that air can circulate beneath them.

Drying agents like silica gel and anhydrite are good for keeping moisture from building up inside air-tight containers. Anhydrite can be made by taking gypsum from sheet-rock walls (strip off the paint and cardboard outer sheet and there it is!) and put the gypsum in an open container and heat it to 400 degrees Fahrenheit (or higher) to drive out the moisture that is combined with the gypsum. The material left behind is anhydrite which will start taking water from the air and slowly turning back into gypsum. Placing it in an air-tight container will allow the anhydrite to bond chemically with the moisture in the container.

Silica gel is often included in the packing of equipment that might need to be stored in the shelter with a drying agent. Silica gel can be purchased from a drug store or ordered in small packets from Phoenix Systems. You can tell by looking at silica gel when the chemical has absorbed all the water that it can; it changes from blue to pink when it's full of water.

To "recycle" silica gel, heat it to 225 degrees Fahrenheit until it changes back to its blue color and it's ready to use again. Be sure to use a thermometer to check the temperature while you're heating the gel; if you exceed the temperature of 225 degrees the silica gel may break down and no longer work.

Just because it's warm when you dive into your shelter doesn't mean it will stay that way. Likewise, if you go into a shelter under winter conditions, you may still have a period of extremely warm "weather" inside your shelter when the heat from all the warm bodies starts to build up. Do some careful planning for all potential weather extremes.

Nylon clothing wears very well and may be useful in a shelter; outdoors, it is NOT too ideal if you're stalking game (or trying not to attract attention) since the plastic material is noisy when you move and rub bits of the fabric together.

Commercial "wind breaker" jackets and much government surplus clothing is at least partly made of tough nylon. (Among my favorite type of clothing for "shelter keeping" is the US Army helicopter pilots Nomex suit. These pants and shirts are made of nylon which is much finer than that used in commercial clothing so that it feels more like cotton. Best of all, the material is fireproof and practically wears forever. Like other military aviation outfits, the suits are designed with a wealth of pockets which is a plus in many survival situations.) Check with the military surplus companies listed in the appendix for some good sources of tough clothing.

Remember that your shelter could be your "home" for months and will probably be your sleeping quarters for some time following a nuclear war. Give a lot of thought to how you're going to build and stock it so that your stay in it will be as pleasant as possible.

SPECIAL EQUIPMENT

One of the most important pieces of equipment you should have is a radiation meter. This is a must for outside operations following a nuclear war because of the fact that amounts of fallout will vary from place to place—or even from foot to foot—since fallout may "drift" when the wind blows it about on the ground. It's therefore essential to have a fallout meter in order not to wander into dangerous areas of contamination even in your own back yard.

A radiation meter would also be very beneficial inside a shelter where it could help you find any hot spots where shielding may not be stopping enough radiation. This would allow shelter occupants to reduce their total exposure just by moving to other safer areas of the shelter.

Another useful piece of equipment is the dosimeter. This is a small, charged tube that loses its electrical charge with exposure to radiation. By looking through the eyepiece mounted on a dosimeter, it's possible to see how much radiation it's been exposed to. If you've been carrying the dosimeter around, you can then assume that this is approximately how much radiation you've been exposed to as well. Thus, it is very useful for finding the total radiation exposure you've received. While you MIGHT be able to get a very rough idea of what your total radiation exposure was with only a radiation meter, a dosimeter will make the job easier and more accurate.

Dosimeters need chargers to give them their electrostatic charges.

Therefore, the third piece of equipment needed is a dosimeter charger.

Good meters, dosimeters (ideally one for each member of your family), and a charger cost a good chunk of money. But they are nearly essential if you are to deal with radiation without making a fatal error in judgement.

A simple radiation meter (actually more like a dosimeter than a meter), can be made for just a few cents, however. It was designed by Cresson Kearny and plans for it are to be found in his book NUCLEAR WAR SURVIVAL SKILLS. If you can't afford a commercial unit, at least make one or more of these. While these meters are a little awkward to use and make, they do work well and are infinitely better than nothing.

A number of companies offer good commercial meters and it's probably a good idea to write to each and see what they have. Victoreen Instrument Division and Dosimeter Corporation are the two major US manufacturers of this type of equipment. Both make several "survey meters" which are capable of working and registering the high levels of radiation that might be encountered during a nuclear war. These meters are rather confusing to use, however, because they have several different scales to select from. To get the correct high-range reading, it is necessary to multiply the number on the scale by a multiple of 10. This can be VERY confusing and may contribute to the making of a serious error if you're not careful when making your reading.

Among the best US-made meters suitable for use in a nuclear war are Dosimeter Corporation's Minirad II (Model 3036-2) which operates on a 9-volt transistor radio battery; the meter is small enough to fit into your shirt pocket. The meter costs $325. The Minirad II has a low-range scale which goes from 0 to 500 mR/hr and a high scale of 0-50 R/hr; care must be taken not to use the wrong setting. (Also, be careful not to place the earphone into the speaker by mistake.)

The only real drawback with the Minirad II is that its scale doesn't go high enough for those who might be in areas with high levels of fallout. You wouldn't want to tarry in fallout greater than 50 R/hr, but it would be good to know how much higher an area was over 50 R/hr if you were forced to be in it. To do your figuring of how fast the fallout would be decaying or where a less "hot" area was would be hard if your meter had gone over the top of the scale. (Also, in my personal experience, the Dosimeter Corporation's meters are not quite as tough as other companies'. Extra care should be given them and avoid dropping them at all costs.)

My favorite meter is manufactured in England. It's the Plessey PDRM 82A. This hi-tech meter uses 3 standard "C" cells which can give it 400 hours of continuous use and the battery compartment is separate from the electrical parts so a leaking battery is less of a problem. The whole meter is sealed water tight.

The PDRM 82A has a microprocessor which actually checks the unit when you turn it on to be sure that it is working (the word "tESt" appears during the test; "FAIL" shows if the unit is malfunctioning). The PDRM 82A continues to test itself while in use with a built-in beta source which it compares to the radiation in the environment. Also, the unit has a digital liquid crystal display so that it is nearly impossible to misread the display. (I've had detectors fail and have made erroneous readings with functioning meters—both events happen with too great a frequency when you're under a lot of stress or pressure. This makes the digital display and built-in checking of the PDRM 82A a real survival plus.)

If the batteries need to be replaced, "BATT" is displayed to the left of the radiation reading and the number "300" flashes on and off if the 300 REMs level is exceeded. The unit was designed for the British Government and has a specified shelf live (without batteries) of at least 20 years when stored in a dry area; you can buy it and store it away for later use without worry.

The PDRM 82A has a continuous reading from 0.1 cGray/hr 300 cGray/hr. Since a CentiGray is equal to a REM, the meter is easy to use. There are also a minimum of controls to set (just an on/off switch which is the lid of the battery container). The display operates in one continuous band from 0.1 to 300 REM so you don't have to switch scales as is the case with other meters. The microprocessor memory in the unit will also tell you if the readings on the meter are going up or down.

The PDRM 82A is EMP-hardened and costs $400 (which isn't too high considering the extra pluses it enjoys). It comes with carrying strap and a lanyard which slips through the slots on its case.

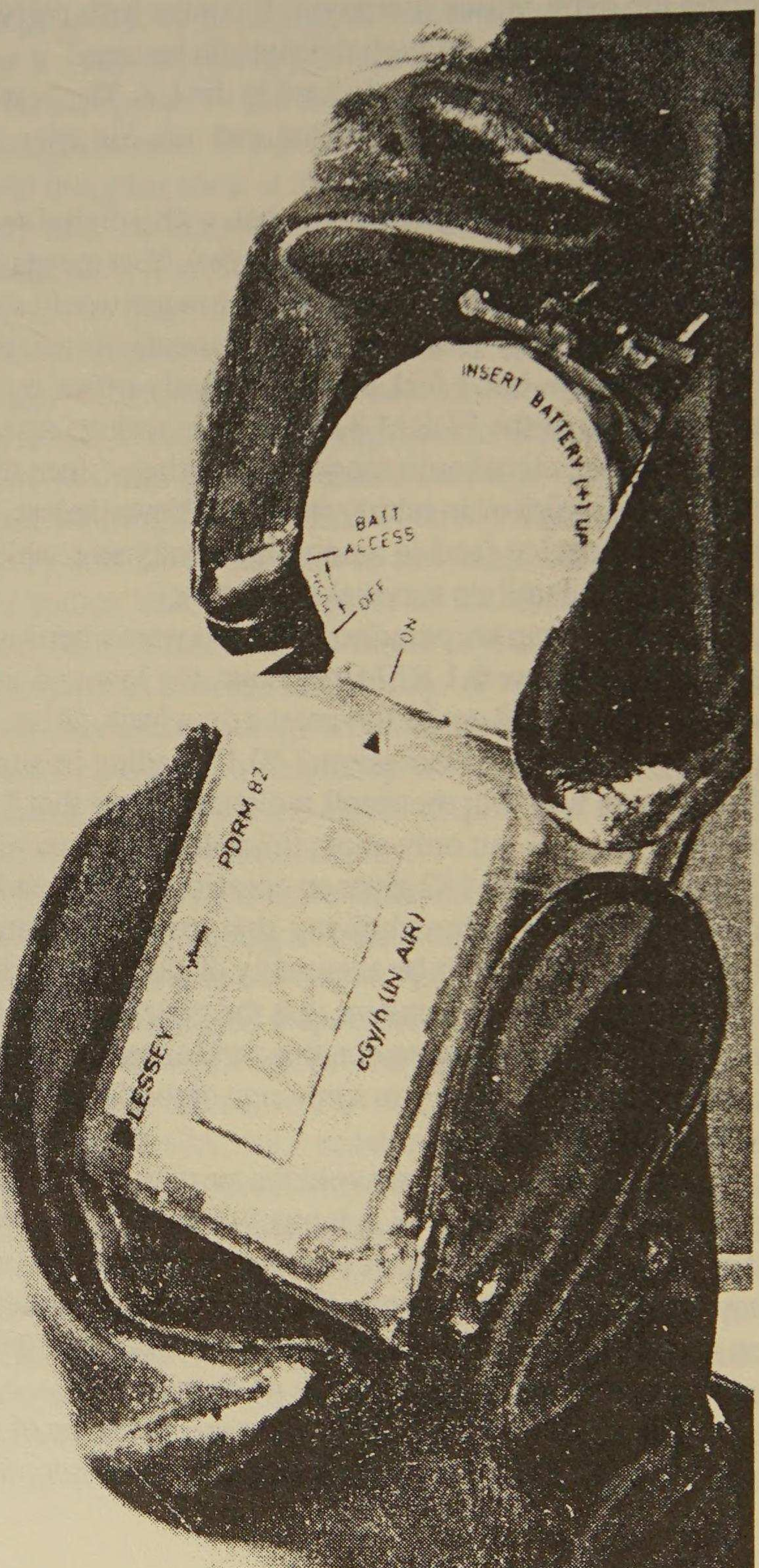
Buying a Plessey PDRM 82A is a little hard in the US. The best bet is simply write to Plessey Controls Limited and ask for price and distributor information.

The only shortcoming of the PDRM 82A is that, with a digital scale, the low-end reading starts at 0.1 R/hr (CentiGray/hr). That means you might be in an area with, say, 0.09 R/hr or less, the meter would show "0.0" while you were actually receiving small amounts of radiation. This would be a problem, but I feel that it is greatly offset by the accuracy and toughness of the PDRM 82A's design and the smaller chance for a user to make mistakes in range scale settings (since there is just one continuous scale) or in taking readings. Nevertheless, the PDRM 82 is my first choice (and is among the equipment which I consider essential in my family's survival equipment).

If the user has a dosimeter to keep track of total exposure when levels of radiation have sunk below 0.1 REM per hour, the low-end inaccuracy of the PDRM 82 would not be too great a drawback. (Also, the PDRM 82 may actually give an occasional "0.1" reading in such a condition. I'm not sure why, but the small radiation source that I use to test equipment with gives out only about 0.3 milliroentgens; when held next to the meter, the PDRM 82 gives an occasional "0.1" reading with the arrow in the up position showing that there has been an increase OR that the reading can't be accurately displayed in a short time. While I've been unable to confirm that the meter will act this way in a lower than 0.1 REM environment, this would seem to indicate that the meter probably would give you some sign of the danger if you watched the display for a while.)

Best advice for those in the US is to avoid the surplus civil defense meters which are still floating around. Many of these require special batteries that are a bit hard to find and you can never be sure how well calibrated they are. Civil defense meters that take common batteries may be stolen and should also be avoided; having a meter that might be stolen could be a serious offense during a nuclear war.

Low-range industrial/medical radiation meters could also be of use in post-nuclear times to check for small amounts of contamination,


PLESSEY
PDRM 82
cGy/h (IN AIR)
BATT ACCESS
OFF
ON
INSERT BATTERY (+) UP

Top view of the PDRM 82 fallout meter showing its liquid crystal display. The only manual control is the simple "on—off" rotary knob which doubles as the battery case top. (Photo courtesy of Guillory and Associates.)

etc. They should be purchased only after you have other needed equipment, however. Dosimeter Corporation is a good source for this type of meter.

Whatever meter you end up with, be sure it has a range that goes up to at least 300 R/hr, gives some indication of when its scale has been exceeded, won't read "0" with readings above its range, and uses standard batteries. When you're storing your meter, leave the batteries out of it so they won't leak and create a disaster and be sure to have a lot of spare batteries which you rotate from time to time so that the ones in storage are good.

Most meters have a strap with them. These can be used to carry the meters but are also of use to hold meters close to the ground. This may be of use to find what type of exposure to expect for small animals or plants or for finding areas of ground that need to be stripped of top soil before being used for planting food crops. (When walking in a contaminated environment, if you hold the meter at chest or waist level, your feet get a higher exposure than the meter reads and your head, lower. But, if you're holding the meter at around waist level, it will show your average exposure rate in R/hr—or whatever the meter is calibrated to.)

Be sure to keep in mind the fact that most radiation meters show the rate of exposure not total exposure. When taking a radiation meter into a heavily contaminated environment, it can be sealed in a plastic ziplock bag to simplify decontaminating the meter; just take off the bag and discard it.

Before leaving radiation meters, mention should be made of the "Personal Radiation Detector" which is a small chemical device designed to detect 3 REM/hr or more of radiation. This small unit has chemicals sealed in it which glow when exposed to radioactivity. Thus, it can be seen to glow when levels of radiation reach 3 REM/hr and reaches magazimum color (a bright green in dim light) when 5 REM/hr or more of exposure occurs. The big plus of these little units is that they are small—they can be used as a key chain or placed on a zipper of a jacket—and inexpensive—only $15 each (from Phoenix Systems, Inc.). The units have indefinite shelf life and don't ever need to be recalibrated. While they give only limited information, they can be carried anywhere and would at least give the user some warning of dangerous radiation levels. As such, they make an ideal addition to a lady's purse or anyone's brief case, lunch box, car pocket, etc.

Dosimeters are about the size of a small ink pen. They can be used to give you an idea of what your total exposure to radiation is. A dosimeter can be worn at the waist, on a chain around the neck, in a breast pocket, etc. Don't place them at an extreme, however; placing them in a boot or hat could give erroneous readings since the dosimeter would be closer or farther away from the source of most fallout radiation.

Dosimeters should ideally read from 0-600 or 0-200 Roentgens (REMs). Lower scale levels might go "over the top" of the scale and then you would have no idea of what your total exposure was; milliroentgen dosimeters designed for medical work are nearly useless in a nuclear war situation.

Keeping careful track of dosimeter readings is important so that you can figure out how much more exposure you can face. Knowing that you could spend an extra 15 minutes outside without becoming ill while you did an essential task might be a very important bit of information.

A carefully-kept log is the way to keep track of total exposures. At regular intervals, take a reading from your (and other) dosimeters and write each one down. Then recharge and zero the dosimeter(s) so that you can continue to get readings. By adding up the readings you can figure out your total dose and will have a record of how spread out the various doses are by checking the dates when the readings were taken.

Dosimeters are read by pointing one end toward a light source (even a match will work) and looking through the other end telescope-style at the small scale inside the dosimeter (the scale is usually marked in Roentgens which are—for our purposes—equal to REMs). The small hairline indicator will tell the total dose the dosimeter has received since it was zeroed.

Some dosimeter chargers have a small light built into them that allows you to view the dosimeter. This works well PROVIDED either the charger or dosimeter has a shield to prevent recharging of the dosimeter without removing the shield. Otherwise, it's possible to accidentally recharge the dosimeter and lose the reading; this can be frustrating to say the least.

Dosimeters should also be read by pointing them at the same angle each time. Readings can change by several REM if the unit is pointed horizontally and then vertically, etc. Ideally you'll read it vertically since that will be the way you'll be looking at it when you recharge the dosimeter. If this isn't practical, check the dosimeter's reading after charging it; if it is not zeroed, re-zero it with a little extra leeway from zero according to which way the error is occurring.

Dosimeters should be stored in a charged state and checked and recharged every month or so. Compare readings of the various dosimeters you have at this point to see if they are all getting the same readings from background radiation and that one isn't malfunctioning.

If a dosimeter is stored in an uncharged condition, it must be charged once, allowed to stand for half an hour, and then recharged and zeroed again. Failure to do this second charging will result in a dosimeter that gives faulty readings.

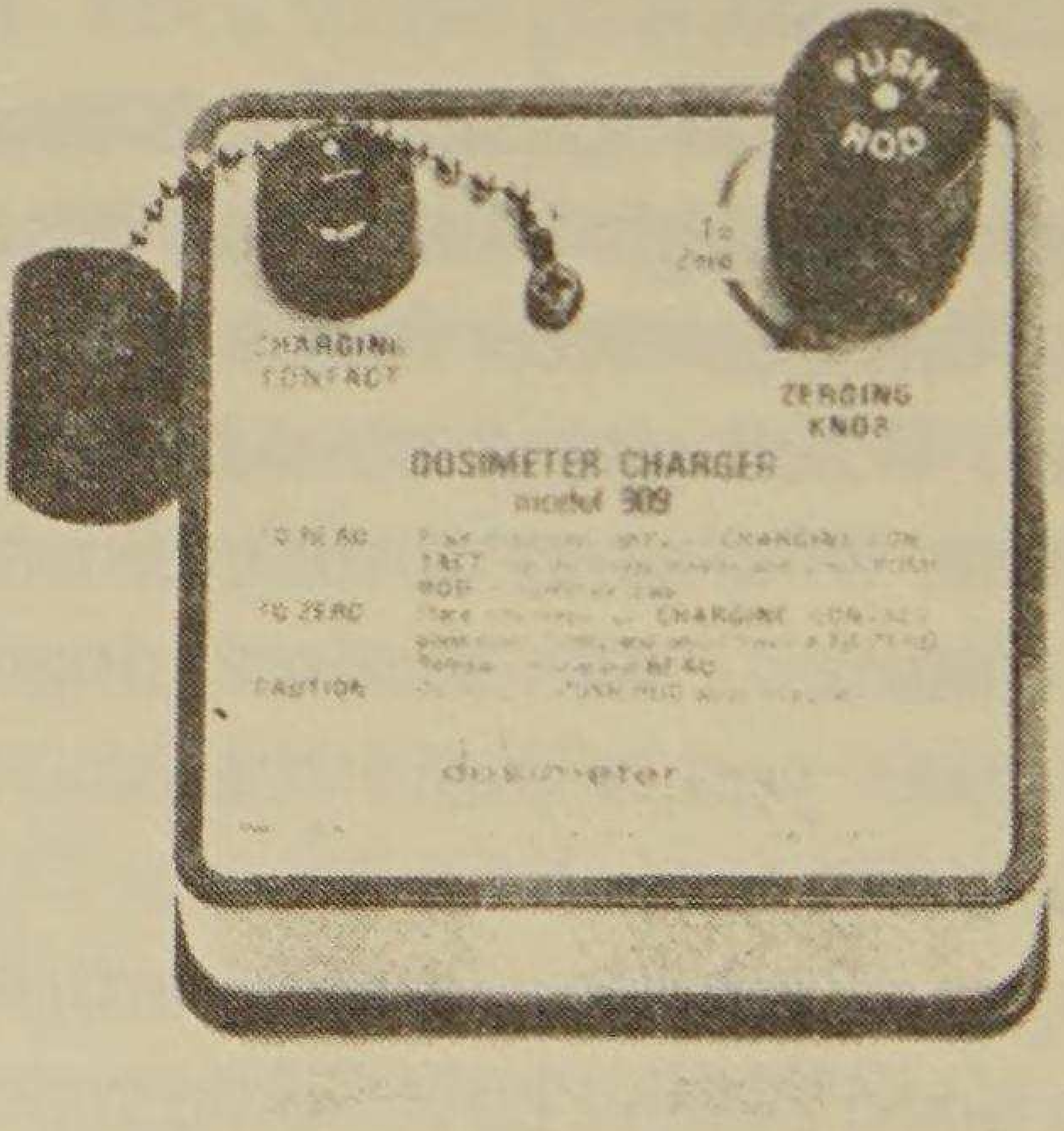
The best source of both dosimeters and chargers is Dosimeter Corporation. Their 686 is ideal with a reading from 0-600 R and has a plastic cap to protect the dosimeter's charging contacts. It also has a clip on it so that it can be kept in place in your pocket. Cost is $60 per dosimeter. The 909 Dosimeter Charger is well designed and uses a D-cell to work. It costs $90.

If you can purchase only one dosimeter, it could be placed in the shelter and used to give a rough idea of the dose each member was receiving. But having one dosimeter for each member of your family would be more ideal. When going outside the shelter into a contaminated environment, wear your dosimeter inside your protective clothing. This will minimize the decontamination needed for the dosimeter and also give you a more realistic idea of what your radiation exposure actually was.

Because of the danger of inhaling fallout particles when outside the shelter, it would be a good idea to have some type of dust mask when you venture out. This could be as simple as a damp, folded handkerchief held or taped over your mouth and nose but a commercial mask is more ideal.

200 mR
GAMMA
& X-RAY
DOSIMETER
862

Dosimeters are about the size of a short, fat ink pen. The Dosimeter Corporation's dosimeter has a clip on it and a protective plastic cap; these aren't found on all dosimeters. (Photo courtesy of Dosimeter Corporation.)


PUSH ROD
CHARGING CONTACT
ZEROING KNOB
DOSIMETER CHARGER
model 909
TO ZERO
CAUTION
dosimeter

A dosimeter charger is necessary if dosimeters are to be of any use. This Model 909 from the Dosimeter Corporation uses a single flashlight battery to do its work. (Photo courtesy of Dosimeter Corporation.)

Many gas masks such as the US Military M17 or Israeli Military surplus masks (currently being sold from Sierra Surplus at a very reasonable price). These are designed to filter out fallout particles and could be used for this. It is usually cheaper, however, to purchase a commercial dust mask and add a good set of sun glasses or goggles to them. The choice of the goggles or sunglasses is important; don't buy cheap ones. They must filter out ultraviolet light since this will probably be at a dangerous levels following a nuclear war.

Both 3M and North make a number of disposable respirators/dust filters which are ideal for keeping nuclear particles and dust out of your nose and mouth. These are readily available at most hardware stores. For those looking for a mail order source of such masks, Lab Safety Supply offers the 3M "dust/mist respirator" for $18.50 for a box of 20. (The company also offers disposable vinyl gloves in sizes small to extra large for $12 for a box of 100.)

Anyone leaving the shelter should also be careful not to track radioactive dust back into the shelter with him. Gloves, rubber overshoes (or even plastic bags taped over your shoes), and old clothing that can all be stripped off and left outside before entering the shelter will all improve things. Use tape to seal the openings in the outfit; don't forget to tape around your wrists and ankles.

Radiation suits are also available on the commercial market. These are mostly designed for use in nuclear reactors or dangerous industrial dusts. These suits give protection against alpha and beta particles but NOT from gamma or neutron radiation. They DO keep the fallout dust from contaminating your skin and clothing under the suit, however, and make decontamination much, much easier.

Currently the BEST (and least expensive) radiation suits are made of Tyvek. Tyvek is a cloth-like plastic which "breaths" so it doesn't get clammy inside in hot weather; but the pores in it are small enough that it doesn't allow fallout dust to get through, however. One good industrial source of Tyvek coveralls is Lab Safety Supply which has a total body coverall (with built in boots, drawstring hood, elastic wrists, and zippered front) which can be worn over other clothing if necessary. The suit comes in small to extra-large sizes and costs only $5.50. By adding goggles and dust filter (or a military surplus gas mask) and some rubber gloves (dish washing will work), it is possible to create a disposable nuclear suit for very little money.

Whatever suit or clothing you're wearing, be sure to brush loose dust and particles from your clothing and shoes before entering the entrance of the shelter and then repeat the procedure inside the first door of your shelter (or just outside the shelter door if you have only one door).

Once inside, remove the tape on your clothing, remove your outer clothing, hat, boots, etc., and place them in the waiting area or toss them back outside the shelter if you won't need them again. Turning clothing wrong-side-out as it is removed will help trap fallout dust inside the fabric IF this can be done with a minimum of shaking the clothing and the clothing won't be worn again.

Next, remove your dust mask and gloves (hold your breath during this so you don't inhale any fallout dust). Discard the mask and gloves or place them with the clothes in a large garbage bag or zip-lock plastic bag until they've been decontaminated or checked for contamination and found free of it if you'll be wearing the clothes again.

Wash in a shower if possible or at least wash your hands and face with copious amounts of water. Clean your fingernails and toenails carefully and wash carefully in all folds and body creases. If possible, wash your hair with soap, shampoo, or detergent.

A new solution is now available which contains chelating agents (chemicals which bond with radioactive particles so that they are easier to remove). This fluid is excellent for decontaminating skin or open wounds which have become contaminated with fallout. The solution is sold under the trade name of Radiac Wash and is available from the Dosimeter Corporation in 1 liter bottles for $15 or in pre-moistened towelettes with a box of 100 being sold for $20. Both the liquid and the towelettes are very effective in decontamination procedures.

If possible, check yourself with a radiation meter to find any fallout you may have missed during washing. If any is found, carefully wash and scrub it off. Discard any rags, towels, or towelettes you've used to clean and dry off with.

Don't go outside the shelter unless you absolutely have to. And if you do go out, be careful not to track dangerous levels of fallout dust back in with you.

WATER

We often take water and food for granted. That would no longer be the case following the onset of a nuclear war.

Of the two, water is the most important. If you're in an area with only light fallout and only need to be in the shelter for a few days, you might survive with just a shelter and some drinking water. Though it's unpleasant to go without food for even a day, if you have some water you can live for weeks without food if you don't need to do a lot of physical work. If you don't have water, you might just as well forget trying to survive beyond a few days.

When radiation levels from fallout sink to safe limits, you'll still need water. Fortunately, though water may be contaminated by fallout, it won't be damaged. Provided you know how to remove the fallout particles, the water can be safe to drink and won't be a problem if you have a good source of water in your area. Know where springs, wells, streams, etc., in your area are so that you can locate water when you need it.

Since most "public water works" will shut down during a nuclear war so that no outside water will be available during your stay in your shelter, you'll need self-contained sources of water if you're trapped by fallout for weeks or months. How much water will you need in your shelter?

Water needs are fairly easy to figure. Each person should have at least a gallon of water per day (a person can get by with 2 quarts per day if it isn't hot, if the person doesn't need to work, and if no water is needed for cooking or cleaning—big ifs).

There are a lot of ways to store the water you'll need. It should be kept where you can get to it and remember that it can be used as shielding for your shelter. If you're not where any shock/blast waves from the closest target would cause much damage to your area, then a swimming pool or large tank connected to the shelter via a pipe might work well in supplying your needs. (We'll look at how to filter and sterilize the water in a bit.)

If you drink pop, milk, or anything else that comes in a plastic containers, carefully rinse the empty containers out and use them to store water. Two liter pop bottles are probably the best since the containers are tough and easy to move and handle. Plastic milk containers work after a manner, but they tend to split easily and spring leaks and—over time—the plastic deteriorates so that they have to be replaced; all in all, they aren't too reliable.

Large 2- and 5-gallon plastic containers are used to store many foods used by restaurants, doughnut shops, dairy queens, and fast food stores. Therefore, a few phone calls will often help you locate sources of plastic containers which are free for the asking or which can be purchased for a nominal price. A little careful cleaning of these and they will be suitable for water (or food) storage. (Large plastic containers are also available from the Survival Center but these often carry premium prices.)

Avoid containers which were not designed for food or water storage or which have been used to store toxic materials like gasoline, paint, solvents, etc. The first group may look all right for water storage but may, in fact, have chemicals in them which will contaminate the water over time. The second group can have chemical residues embedded in the plastic which will leach out over time. Either can poison your water and—in time—make you sick.

When working with any container larger than 2 gallons, be sure to put it where you want it and then fill it with water. They get VERY heavy when full of water. Other large containers like barrels, plastic trash cans, etc., can be used to store water for non-drinking use and can also double as tables or chairs while they are holding the water or can be used for storing trash as the containers are emptied of water. But again: water can leech dangerous chemicals from some plastics; if the container wasn't designed for food or beverages, use water stored in it for washing, not drinking or eating purposes.

Care must be taken with any water container to be sure it isn't allowed to freeze. Ice can rupture many of these potential water containers.

Water bags can be made with 2 large plastic garbage bags nestled inside a pillow case or gunny sack. The cloth supports the plastic bags and gives them strength while the double wall of plastic holds in the water. Just be sure you have a good way to support such a bag and carefully tie up the opening. (Because of chemicals in some trash bags, water from these should be used in a short time or used only for non-drinking purposes.) These bags are awkward to handle so be prepared to spill some water from time to time if you use them.

Plastic sheets can be used to line a hole in the ground to create a water storage tank. Once the hole is full of water, cover it with a sheet of plastic and a board to prevent evaporation.

Glass containers keep water well in long-term storage but can be quite dangerous because they break easily. This means they're more apt to break if the water freezes and would be quite dangerous if the shelter should be shaken by a blast wave. Metal containers should be approached cautiously since many will rust out; water can also take on some odd tastes in metal containers.

Flexible plastic tubing is very useful in connecting water containers to your shelter or for draining water from large containers without dropping junk into the water. A wide range of hand pumps and tubing is available from Industrial Safety and Security Company and Lab Safety Supply; prices for the plastic pumps range from $10 to $30 depending on the model you select.

If you don't have a hand pump, it's also possible to remove water from containers by siphoning it out. All you need is a small length of plastic or rubber hose. To siphon water, the source of the water must have a higher level than the point at which the water is needed. The hose itself must be submerged in the water source but the water being "piped" may travel above or below the level of either the source or the outlet as long as the outlet is below the top level of the water source.

The flow of water has to be started by sucking on the end of the hose (soda-straw style). Once the water starts flowing, gravity—and the vacuum created as the water leaves the tube—should make the water continue to flow. To stop the flow, bend or pinch the tube shut. (Small faucets are available from Industrial Safety and Security Company which can be used on the end of a hose. A hose clamp can also be used for this; they are available at most plumbing stores or—if you're using surgical tubing—use a clamp from a lab supply store).

Pre-moistened towelettes can save a lot of water that might otherwise be used in cleaning chores in a shelter. These towelettes have chemicals on them to cut through grime and grease. Some of the best are designed to be used to clean infants. The towelettes are available in most grocery stores around the baby food section; having some would be a real asset in a cramped shelter.

If you don't have much water to use for washing, your shelter group will probably have trouble with mild skin infections since the unwashed skin coupled with the humid conditions that develop will be ideal for the growth of bacteria and some types of fungus. Have everyone in the shelter sit and sleep in their own spot if you're having troubles with rashes. If everyone avoids contact with areas and utensils used by others, their bodies will have a chance to become immune to the bacteria causing their problems and new ones won't spread from one person to another. Since radiation lowers everyone's immunity to disease, you should take every precaution to prevent the spreading of germs from one person to another.

Don't plan on washing dishes and utensils. Instead, eat out of food containers and have each person "lick clean" their utensils. When each person uses the same utensils for the next meal there will be little danger of spreading diseases. Use plastic eating utensils, paper plates, paper cups, and paper napkins for especially messy foods; since water will be at a premium inside the shelter, throwing these away will be more necessity than convenience.

Once you've got some idea of how long you'll need to stay in your shelter and how much water you'll need, you can get it stored away.

The next problem is making the water safe to drink.

If it's been stored for even a few days it may not be safe to drink. Most water supplies depend on chemical treatment to keep the numbers of bacteria in them at safe limits. The water isn't sterile; it just doesn't have enough living bacteria in it to overwhelm your body's defenses.

When the water sits for a few days, the chemicals will "wear out" as they continue to kill the bacteria multiplying in the water. When the point is reached where the chemicals are used up and can't kill bacteria any longer, the germs will be able to multiply to potentially dangerous levels. To keep from "poisoning" yourself, you'd be wise to sterilize the water after it has been stored for any time at all.

Boiling the water—at a full boil—for 15 minutes is probably the best way to kill the germs. You don't JUST boil the water. You have to boil it for 15 minutes. That's 15 minutes after it starts to boil; simmering does not count. Water must be kept at a complete boil or you risk drinking something that will make you very sick.

Boiling water is not too practical in a shelter. So you'll probably want to use chemicals to kill the bacteria in your water. In addition to water purification tablets, two useful chemicals for sterilizing water are two percent tincture of iodine and sodium hypochlorite—the active ingredient found in most household bleach. With two percent tincture of iodine, use 5 drops per quart of water; with 5.25% sodium hypochlorite solution—bleach—use 2 or 3 drops. Double the amounts if the water is cloudy or smells bad. The killing of the bacteria is not instantaneous; be sure to let the water stand for a half hour before drinking it. Of the two chemicals, iodine is the most effective in killing bacteria; it also tastes worse.

(Iodine crystals can be used but aren't too practical. Too, the chemical is easily mixed up in the wrong proportions. And when the crystals are being mixed with water they give off poisonous fumes; this does little to promote your good health. You're better off with one of the other chemicals. Nevertheless, if you are stuck with iodine crystals, here's how to use them: Use a measuring device of some type to measure out 4 to 8 grams of the iodine crystals. Place these into one ounce of water and stir for three minutes. After stirring, allow the crystals that do not dissolve to sink to the bottom and use 7 milliliters of the liquid from the top of the clear solution you've created to treat each quart of your water. Do NOT allow any undissolved crystals to get into the water you're drinking; ingesting a crystal will make you violently ill.)

Replace your water purification stocks of either hypochlorite or iodine every few years since they'll lose their potency over time. If you're using old chemicals, increase the dosage to make up for the loss of potency. Also, remember that these chemicals are poisonous; don't let your children have access to them and don't use too much of any of the chemicals.

There are two types of purification tablets: tetraglycine hydroperiodide (an iodine compound) and halazone tablets (a chlorine compound). The tetraglycine hydroperiodide is much better to use than the halazone tablets; some viruses and amoebic cysts are NOT killed by the halazone. The iodine compound is sold under a number of trade names: Potable Aqua, Globaline, and Coghlan's among others.

Shelf life for tetraglycine hydroperiodide tablets is up to four years IF they are kept sealed, not exposed to bright light, and kept cool. Halazone tablets will remain useful for 2 years if kept cool and sealed airtight. Avoid military surplus purification tablets since the tablets, over time, tend to lose their ability to kill organisms which might be in the water.

To use purification tablets, follow the directions on the container. (If directions aren't available, for MOST tablets the following will work: use 2 Halazone tablets per 2 quarts of clear water. Chlorine tablets should be used 5 per quart and Potable Aqua tablets 1 per quart. Double the number of tablets for hazy or foul-smelling water. Wait for 30 minutes after the tablet has dissolved before using the water.)

Following a nuclear war, it is possible that untended chemical plants or the like may contaminate large aquifers and other sources of drinking water. In such a case, a filter should be used to make the water safe to drink. (Distillation will remove many solid particles and sterilize the water; but some potential contaminants have a higher boiling point than water so that they can not be removed from water with most home distillation units.)

You can make a simple carbon filter to clear hazardous materials from your water. While constructing one is a lot of work, once it's made you can keep it going for some time during a disaster—this isn't the case with many commercial units.

As you would think, activated carbon (also called activated charcoal) is the main material needed for a carbon filter. Activated carbon is created from coal or wood which has been processed at high temperatures with steam in the absence of oxygen. Activated charcoal (the processed wood or coal) is very porous and, when broken into small particles, has a large number of surfaces. This allows the activated carbon to "latch onto" a number of chemical compounds so that they become bonded to its surface.

You can purchase aquarium activated carbon (at your local five and dime) and store it for later use. Keep it in air-tight containers or it will pick up gas from the air and deactivate itself.

You could make activated carbon by placing wood in a sealed container with only a very tiny hole in it and heating it until the wood is charred into activated carbon. Ideally, a tube leading into the container would be used to force water onto the wood to create steam inside the container though this is not essential. (The main consideration is to not allow air to get to the charcoal when it's being heated while having a large enough hole in the heating container to keep it from exploding when the hot gases in it expand.)

Activated carbon bonds with a number of chemicals including many pesticides (both DDT and Deeldrin), many industrial chemicals (carbon tetra—chloride, PCB's), heavy metals (lead, cadmium, etc.), and many of the dangerous chemicals created by industrial wastes during chlorination (including chloroform). This makes it ideal for post war pollution problems.

Bacteria can grow on the surface of wet activated carbon and—strangely enough—will often grow quite rapidly in the presence of some of the pollutants removed by the carbon. To avoid this, change the carbon regularly to keep from creating biological contamination of drinking water. (With regular changing of the carbon in the filter, the levels of bacteria contamination are generally believed to be within safe limits for healthy individuals. However, the bacteria might adversely affect infants or those individuals who are sick or weak—

which might be the case for everyone during a nuclear war.)

There's some indication that continued exposure to carbon may cause cancer in the gastrointestinal tract; be sure to use filter paper, coffee filter paper, cloth, or other "expedient filters" to remove particles of activated carbon from your filters water.

Making an activated charcoal filter is quite simple. Probably the easiest way is to get a funnel, a coffee filter, and a collecting bottle (or can, cup, jar, etc.) and line the inside of the funnel with the coffee filter, fill the inside of the filter with carbon, and DRIP water into the funnel. As the water slowly moves through the carbon, it becomes purified and drips out the bottom. Boil the water (or use chemicals to kill the bacteria that may be growing on the charcoal) and the water is ready to use.

Be sure only a few drips go through the filter at a time and don't let the water flow between the filter paper and the edge of the funnel. Change the charcoal every 3 weeks or after 20 gallons of water have been filtered.

If you're getting water from outside, there may be fallout in the water. While the fallout may be at a safe level for OUTSIDE your body, the inside of your body is much more sensitive to radiation damage and—as mentioned before—tends to store some isotopes in certain organs where the dosage becomes more dangerous because of the higher concentration. Therefore, you need to go through an extra step BEFORE you use an activated charcoal filter and/or sterilize any water which may have fallout in it. (Fallout doesn't harm water and the radioactive particles—except for those in gaseous form—can be filtered from the water.)

There are several ways to remove fallout particles from water.

One way is to strain the water through a paper towel or several layers of clean cloth (neither cloth or towel can be contaminated by fallout, of course). A coffee filter also works well for this if you want to buy some just for this purpose. The water must flow slowly through the material into a second container.

Remember to treat the filter material as if it were full of deadly, radioactive poison—because it may be. Dispose of this filter material as soon as possible.

A more efficient earth filter design can be made with a five gallon can or bucket. If you have a large can or bucket, it's pretty easy to make one of these filters. Just punch small holes all over the bucket's bottom, cover the bottom with several inches of small rocks (or twigs), spread a finely woven cloth over the rocks, and—on top of the cloth—place 7 to 10 inches of soil (don't use sandy soil—any other type will work). To use this filter, let the fallout-contaminated water trickle into the top of the earth filter and catch the water as it drips out of the holes in the bottom. After the filter has been used for a while, replace the rocks, dirt, and cloth and start over.

If water may have fallout in it and you can't filter it, allow the water to sit, undisturbed, for 24 hours. During this time, larger foreign matter in the water will settle to the bottom of the container. Provided you carefully and slowly pour the water from the container and leave the last of the liquid in the container, you would avoid most of the fallout. (Dispose of the last bit of water and fallout carefully.)

As with other water sources, be sure to sterilize the water after filtering or otherwise removing the fallout from the water before drinking it.

Because of the terrible taste that water may take on after being stored and sterilized, you would also be wise to keep large stores of instant tea, kool-aid, etc., to cover up the bad taste of the water.

It is wise to be aware of natural water sources around your home so that, once radiation levels sink to safe levels, you can go out and obtain water. It would seem probable that many areas would not have running water for some time. Therefore, if you can't supply your own water, you'll be in big trouble.

Water from springs, wells, creeks, or anywhere else should be filtered to removed fallout contaminated and sterilized using the methods outlined above.

Having an emergency supply of water in your home could save a lot of drudgery. With the average person using tens or ever hundreds of gallons of water a day during normal activities, you'll have to plan on either greatly lowering your water needs following a nuclear war or have a source of water very close by.

While a few lucky souls have a near-by spring or creek from which water can be diverted into their living area, most don't have that luxury. But, in many areas, a water well can be a viable solution to the problem.

The art of digging or drilling a water well has nearly become a lost art in the US. The main "secret" to creating a water well is finding the proper location for it. Space doesn't permit going into this in great detail, but an important point to keep in mind are that water tends to seek low points; a well drilling operation is more likely to strike water at the base of a hill than at its top (or at least you'll reach it sooner). Also, keep in mind the fact that care must be taken not to dig a well where the water might be contaminated by sewage systems, chemical contaminants, surface run off or the like.

("Old timers" claim that one of the best ways to find water which is within 20 to 30 feet of the ground is to find a spot where willows or cottonwood trees are growing naturally—not planted there—and flourishing. Water is generally close to the surface of the earth in such areas.)

There are a number of books which outline the best methods of finding the proper site for a well (along with a lot of other helpful information). Among the best of these is the Water Well Manual by Ulric Gibson and Rexford Singer (available for $9 from the US Government Printing Office, Washington, DC 20402); this book explains what you need to create—or find someone to create—a modern well.

Another good aid is a regional map of your area showing surface drainage and rock types in your area and tracing the source of your ground water. Maps from the American Association of Petroleum Geologists Bookstore (P. O. Box 979, Tulsa, OK 74101) will help you out as well many local county extension agents. Other good literature includes: Water Supply for Rural Areas and Small Communities ($28 from World Health Organization, 49 Sheridan Ave., Albany, NY 12210); Manual of Individual Water Supply Systems (US Government Printing Office); Planning for an Individual Water System ($7 from American Association for Vocational Instructional Materials Engineering Center, Athens, GA 30602); and Ground Water Manual ($14 from the US Government Printing Office).

The surest way to have a water well available for emergency use is to have a well drilled by a commercial driller NOW and then leave it covered but ready-to-go if you don't need it now. Having a water well ready would save a lot of tears and sweat and really make the transition from your municipal supply to your own well considerably less traumatic.

For a do-it-yourselfer, it is also possible to dig your own well so that it will be available later for an emergency. The key to doing such work is a small well digging machine called the "Hydra Drill." The device comes with its own hoist and power unit and can dig a well up to 3-1/2 inches wide down to 200 feet. Cost is slightly over $500 and information on the unit is available from Deeprock Manufacturing (Box 1, Opelika, AL 36802).

If you have to dig a well following a disaster, you'll have to do so without any specialized machinery or power sources. Blasting, water-jet drilling, etc., are all out. Post-nuclear war wells will have to be dug using mostly muscle power and methods used by our forefathers. (While hard to do, you should remember that, not all that long ago, this was THE way of digging wells.)

Digging and shoring up the hole as it is dug can be done with only a spade, but such work is hard, slow, and very dangerous. Furthermore, once in, a shovel-dug well is dangerous since children often manage to fall into them.

Another large problem has to be faced since shoring systems are normally based on straight boards which create square shafts and, in turn, square-walled wells which are very inferior in strength to round-walled wells. Added to the problem is that the wood shoring will gradually rot, swell with the moisture of the well, and—eventually—cave in. This means that, if the well is to last, it must be lined with rock which is MAJOR work. (Modern hand-dug wells in Third World countries use large, precast concrete cylinders—sometimes augmented with a cast-in-place cylinder at the top of the well—in which the workers dig. As dirt is removed from the base of the well, the cast cylinder sinks into the excavation acting as a caisson. But such large-scale wells are really impractical in an emergency situation unless you have a large community of workers to help.)

A better route to take in well digging is to work on a small scale and create a well of a smaller diameter. In areas with very firm soil (little sand in the dirt) and where ground water is 50 feet or less from the surface, a well can be put in using just a hand auger. (Hand auger bits are sometimes used for digging post holes and can be found in many farm communities at supply stores or ordered through most Farmers' Co-Ops.)

The auger is "hand powered" by twisting it into the ground until the screw head is filled with dirt. At that point, the auger is lifted out of the hole and the dirt knocked out of it. As the well hole deepens, the handle is removed from the auger and a length of pipe added to it to make it longer so that the hole can be dug farther into the ground. As the length of the pipe on the auger becomes greater, a 10-foot or higher platform is normally made over the well sight so that the auger can be pulled out by a man on the tower working in conjunction to another on the ground. When water is reached, an "augered" well is lined with pipe or concrete sections to keep it from caving in or becoming contaminated with run-off surface water (these are important considerations not to be overlooked in digging such a well).

In areas where the soil is sandy, auger digging doesn't work too well since the well tends to cave in before the water is reached. A digging method which works well in such soil is the "sand point" or "driven" well. Such wells are pretty simple and quick to drill and might even be done on a "make do" basis with household plumbing pipe (though the flow from such a well would be rather small). The sand point well works best when the water is within 30 feet of the surface (which is often the case in areas with sandy soil).

One requirement for drilling a sand point well is to have the "point" which, as the name suggests, has a pointed, spear-like end which is easily driven into the ground. The point section also has a number of small holes in it so that water can flow into it while sand and dirt are filtered out.

The best method of obtaining a point (and the pipe coupling to connect it to) is simply to go to an irrigation supply company and buy it (again, good places to try are local Farmers' Co-Ops or a farmers supply store). In a post-war situation, it would be possible to make a point section with judicious grinding, shaping, drilling, and welding; but this would entail a lot of work.

The sand point is usually driven into the earth by some sort of weight which is dropped from a pulley hoist or the like. The tool designed for this is called a "bell"; the heavy bell driver fits over the end of the pipe and has handles on either side so that a couple of stout fellows might use it without a hoist. (In a real pinch, it is even possible to use a sledge hammer rather than a bell to drive a sand point into the earth.)

The top of the point and each section of pipe that is fitted to it as it is driven into the ground are threaded. This allows them to be joined as the point goes down into the ground. The catch to the threading is that it's easy to ding it up, making pipe joining impossible. The secret to this is to use a protective cap on the threading. Provided it is screwed tightly into place over the exposed threaded end of the pipe or point being driven into the ground and a number of weaker blows to drive the pipe rather than humongous heavy blows, this generally works in protecting the threads.

After a section of pipe is driven most of the way into the ground, the end cap is removed from the pipe, a coupling is threaded onto it, and another piece of pipe fitted onto it. The end cap then goes back on top of the new section of pipe to protect its threads. (Care must be taken to check the protective cap from time to time as the section is being driven into the ground since the cap will tend to work loose under the blows of the bell; if it comes loose and the cap is hit, the threads can be ruined. And ruining the threads means you'll have to abandon the sections of pipe in the ground or rethread the section by hand.)

Larger diameter sand pipes can be driven by a weight inside the pipe. This has the advantage of not damaging the threading on the pipe but is also a bit slower since the weight has to travel farther as the well gets deeper.

Generally, five foot lengths of pipe are the maximum size to be used with a sand point well. When joining each section of pipe, plumber's pipe compound will help prevent leaks and/or air getting into the pipe when you're trying to pump water through it later on (and also makes screwing the pipe together a bit easier).

Holes in the sand point sometimes clog up and the amount of flowing water drops down (often leading the user to think the well has run dry). One old method of unclogging the holes was to fire a small caliber rifle (usually a .22 LR) down the well two or three times. This generally seemed to work quite well, though one has to wonder if the lead of the bullets might have raised the lead content of the water to rather high levels; handloaders might want to try light charges in centerfire guns with copper or brass bullets. Care should also be taken to be sure water doesn't get into the barrel before it is fired.

A cased well can also be dug by hand; such a well uses a string of connected sections of light-weight casing. The casing shell is slowly lowered into a hole which is dug from inside the casing itself with an auger in clay soil or with a tool called the bail cup or bail bucket in sandy soil.

Bail cups have a number of different designs. In sandy soil, the tool is like a long bucket with a hinged valve at its bottom. A weight slides up and down inside the top of the bucket and the rope connected to the bucket to pull it back up is connected to the weight. When the bucket is pulled back to the surface after being dropped into the sandy soil, the suction of the weight tends to pull the sand upward momentarily and the valve shuts below it to keep the sand in it.

Another type of bail bucket consists of a heavy set of blades which first cut into the dirt and then tighten up to take a bite out of the ground which will remain in the bail as it is hoisted back out (this type of bail bucket works in a manner very similar to a two-handled, manual post hole digger or some cranes used for earth moving purposes).

When the case well is being dug, dirt, rock, and sand are removed from below the casing. Once this is done, the casing can be pushed down and other sections added to the casing from above. The maximum practical depth for a cased well driven this way is about 50 feet. Sandy soil is considerably easier to do this in than is clay soil.

The bail is most easily moved up and down on a small hoist built above the well. This allows the bail to be dropped down the casing shaft; a pulley is a great aid in hoisting the bucket and dirt up out of the well. Such work is best done by a number of strong men with a tractor, car, or other motorized vehicle being most ideal for hoisting the bail bucket.

Getting the water up out of a well is usually achieved with an electric pump. Unfortunately, this may not be a viable option during post-nuclear war times. Fortunately, it's also possible to use a hand pump on wells. With a cased well, a surface pump dictates placing a pipe inside the casing; however it is also possible to simply drop a bucket or similar container fastened to a rope down into a cased well and then pull it out after it has filled with water.

(It should also be noted that old cased wells are very common in some areas of the country. During an emergency, it would be possible to decouple and remove electric pumps from these wells and use a bucket, can, etc., on a rope or string to bring water up out of the well. This would be slow going but could be used to supply drinking water when none was otherwise available.)

Hand pumps aren't real common anymore and are best located and purchased well before a nuclear war starts. Two of the best-known, and still available, of these pumps are the Dempster pump (Box 648, Beatrice, NE 68310) and the Monitor pumps (133 Enterprise St., Evansville, WI 53536). Prices of these range from around $90 to $300 or more depending on the options you need on them (like drinking fountains!), volume you'll be pumping from the well, and the depth of your well.

Windmills—wind driven pumps—are practical in areas having a wind which blows 5 mph or more for long periods of the day. Windmills are a bit unsightly and need to be about 15 feet above surrounding trees and buildings to function well; this makes them undesirable to many and could create a "point of interest" to looters or scavengers if care isn't taken by the well owner.

A windmill does have some real pluses. When coupled with a storage tank (preferably inside in areas where the temperature gets below freezing from time to time), the windmill can supply a large amount of water to a household and, when used with a pressurizing tank and pump, the water can be supplied with enough pressure to make the water flow freely throughout the house even if the tank is lower than the fixtures. Dempster (at the above address) and Heller-Aller (Corner Perry and Oakwood, Napoleon, OH 43545) are the two best known companies which make windmill pumps.

A windmill (or other source of power) can also be used to compress air. This air can then be used to do various types of work including running an air-driven pump located at the bottom of a cased well. This creates a water system which can be connected to a house's piping to put "water on the tap" just as "in the big city." One maker of such a pump is Stauffer's Machine Shop (RD 3, Pleasant Valley Rd., Ephrata, PA 17522); cost is around $300 to $400 depending on the size and capacity of pump needed.

It should also be noted that many pumping systems can "lose their prime." This means that the air-tight seal is lost and the water in the pump and pipe leading from it drop their water down to the level of the water source. Many pumps can't overcome this problem without having water added to the pump to "prime" it. This should be remembered and an "emergency priming" source of water kept on hand at all times.

Spare valves for pumps are also a good investment since these seem to be one of the first parts to wear out. With these spare parts and careful following of the manufacturer's recommendations on lubrication and use, a good water pump will last a long time.

Don't under estimate your water needs. Without water, you can't survive for long.

FOOD

Food could be scarce in many areas if there are many survivors in the same place. Although the US has enough food stored away to feed its people for some time, distribution of food reserves will be next to impossible over any distance. The US Office of Technology Assessment, in a 1979 report which was created to predict possible complications that might follow a nuclear war, wrote, "For a period of time, people could live off supplies...left over from before the war. But shortages and uncertainties would get worse. The survivors would find themselves in a race to achieve viability before stocks ran out completely. This post-war... [race] could be as devastating as the damage from actual nuclear explosions."

Compounding the problem is that, through shortsightedness, the US has managed to place most of its current missile silos in the middle of its most valuable farmland. Since these targets require ground bursts to be damaged, the US has almost guaranteed that the soil will be covered with fallout. While this may change in the future if the US depends more on submarine-based missiles, the situation will probably remain in the near future. Since no plans are currently being made to protect farm crops or livestock, the damage done to US farmlands would be extensive.

An attack's damage to the farmland would also depend a lot on the time of the year in which it occurred. An attack between October and January would have a minimum long-term effect since fallout would be at its most dangerous levels when most crops and animals were not in the fields; an attack in July or August would also have little effect since most crops are already harvested. An attack in February or March would delay planting and reduce crop yields while an attack during April through May could destroy an entire year's crop yield—both potential food and the seed crop as well.

A lot of grains in storage will probably have become moldy or vermin infested due to lack of electricity, use of insecticides, and proper care during this time as well. Consequently, those who survive will need to be able to raise their own food or be in an area capable of producing food in enough of an abundance that it can be traded for services and other products. Since a nuclear war could stretch out or be fought with waves of attacks, it's possible that large-scale agriculture wouldn't be able to get started for years.

Even if a war were to end in a hurry and the food in storage areas remained eatable, you still probably wouldn't be receiving government help in the form of food shipments. Major disruptions in manpower, lack of fuel for trucks and trains, and destruction of much of the transportation system makes shipments a doubtful proposition. And even if food gets out to your neck of the woods, it's probable that the government will use the food to organize civilian labor forces bordering on forced labor if current government plans were to go into effect. You'll need to produce your own food.

This means that YOU are going to be the only one you can depend on to supply your needs for food and water for some time following a nuclear war.

Since no outside food will be available during your stay in your shelter, you'll need self-contained sources of both water and food if you're trapped by fallout for weeks or months.

Let's digress a bit. Think about one of the critical points that many who don't store food for emergencies raise: that storing more food than you need is hoarding (this is especially popular with the anti-survival segments of the media as well as the non-thinking public).

For some reason, some people act as if preparing to survive a war is going to cause it to take place. And if a nuclear war does take place, these people seem to think that, following such a war, everyone should take care of those who didn't make an effort to prepare.

Listening to these people talk will reveal another strange way of thinking. They seem to think that anyone who's taken the time to store the food should throw open their doors and feed everyone that demands food during an emergency—even though that means that no one will be able to survive for long. Now who's being selfish?

The person who stores food for his family when there's plenty of food available is doing the wise and moral thing. Isn't the immoral person the guy who didn't store food or prepare and then demands that everyone share with him when food supplies are very small?

Since the majority of those living in the US, according to independent surveys, think there's a good chance of a nuclear war in the near future, it isn't like you have some great secret that a war is possible. If a group of people knows of an impending disaster and some do something to survive it and others don't, who is in the right and who is making the mistake?

Certainly those who prepare are the most prudent and the LEAST criminal. The people who are derelict in their duties are those who do NOT prepare.

Food is plentiful today. Buying and storing food while it's plentiful is not hoarding. It's stockpiling. Stockpiling is saving for a "rainy day."

(And in fact, with American agriculture without enough of a market, it is surprising that the US Government isn't encouraging people to buy and store extra food for emergencies.)

Many of those who refuse to stockpile food while it is plentiful will be the ones who rush to the stores and strip them before an impending nuclear war. It gets worse, though, because many of these people will, if pressed, admit that they'd do ANYTHING to keep their family from starving during a nuclear war (anything but store food ahead of time, that is).

Again, who is immoral? Who will become the criminal? The most dangerous person around following a nuclear war will be the guy who has not prepared to survive but does.

It doesn't end with individuals, however. A lot of information currently available suggests that there may be a big push by the government to confiscate food following a nuclear war so that the food can be used to force people to work to get the country rebuilt again. Now is the time to start thinking about whether or not you'd be willing to surrender your food or hide it, etc. If you decide you don't wish to share it at gun point, you'll need to take extra steps to keep the fact that you're storing it secret.

Whether the government survives to try to take your food or not, it's probable that you'll have to deal with people who don't have as much food as you do. Many who plan on surviving a nuclear war actually are storing extra food and supplies so that they can help others survive. These would-be survivors are hoping to encourage the rebuilding of the economy in their area by using their extra food for barter purposes. Thus, they'll feed those in their area and also get trade and services restarted. (Self-defense should still be considered in such a situation; we'll be looking into that in the next chapter.)

At any rate, those who refuse to store food coupled with a number of "emergency laws" which allow the US Government officials to take "surplus" food and supplies from individuals and redistribute the goods, make it a good idea for you to keep a very low profile when buying and storing food. (Those who saw how the US government took care of many of the surplus items gathered for "the troops" during WWII tell of very wasteful practices. Mounds of supplies that were "stockpiled" were often seen left in the open to rot. What would happen under less organized times following a nuclear war? It seems probable that an emergency government would end up making even fewer survivors once it started "stockpiling" food by stealing it from those who had been wise enough to save it for themselves.)

Don't feel guilty about trying to provide for your family and don't feel bad about keeping such food a secret. Your family is your first responsibility and you should not be forced to care for those who don't care enough to take any steps—other than stealing—to avoid what they seem to know could be coming.

Too, if you've stored food and supplies, then you actually are helping things quite a bit. In an emergency, you won't have to be competing for the little there is in stores. If a large enough number of people stored surplus food and supplies, then the folks who aren't foresighted enough to do the same might still find enough to get by with their "last minute shopping."

That said, how much food should you have? Ideally, you'd have at least a month's supply of food which you can store inside your shelter (and maybe a lot more if you are in a high fallout area). This will allow you to stay inside your shelter when fallout levels are high in your area.

But what are you going to do for food after that? It's possible that there will be no meaningful trade or even a good growing season for perhaps a year following a nuclear war. The only way to get through such a period is to have food stored for your whole family or to be able to grow it during that time. (This additional food needs not be stored in your shelter but should be where it can be protected from being stolen.)

The catch to food storage plans is that foods have a finite life during which their nutritional content remains high. Once this shelf life is exceeded, the nutritional value of the food gradually drops off. While "out dated" food will remain eatable for some time and even supply some nourishment, it will not necessarily supply all your body's needs.

Canned foods have a shelf life of around 6 months though some will stay nutritious for a little longer; canned meats and non-citrus fruits can be stored for up to a year. So if any of your storage food is in cans, then it should be rotated to your daily food supply and replaced with new cans about every 3 or 4 months if it is to supply you with its full amount of nourishment when you need it. (Home-canned foods have a shelf live similar to commercially canned foods.)

Evaporated milk should be rotated every 4 months. It should be part of your food storage program if you have children so that they'll have a good source of calcium (which helps displace the body's intake of Strontium-90) as they grow. If possible, take evaporated milk out of its box and place it in a plastic or metal container for long-term storage so that mice can't get into it.

Bouillon, instant cream, nuts, cereals, and hydrogenated (or anti-oxidant treated) fats/vegetable oil all have shelf lives of nearly a year. Coffee, tea, cocoa, candy (that isn't nearly 100 percent sugar), spices, etc., can be treated as if they have shelf lives of a number of years. (Because they have no food value, they will only deteriorate in their taste over a long period of time. Sample these products from time to time to be sure the taste hasn't become too poor to be of use or—if you prefer not to waste them—rotate them every two or three years.)

While rotating the cans to keep them current is a hassle, canned food and other grocery-store-purchased food is probably the cheapest of the many ways to store ready-to-eat foods for use during a nuclear war.

One of the new types of foods to come onto the market—via way of NASA space work—is freeze-dried food. Similar to freeze-dried food is dehydrated food. Both have longer storage lives than do canned foods and taste better than many canned foods. They're also much more expensive.

The longer storage life of these foods allows you to purchase them and not use or replace them for 4 or 5 years rather than every 4 to 6 months as must be done with canned goods. (Although the companies selling freeze-dried and dehydrated foods claim that the shelve life is next to forever, most authorities not connected with the companies feel that after 5 years things get pretty iffy from a nutritional standpoint).

Currently, there is a "crunch" in the freeze-dried/dehydrated food business and companies are coming and going. Check with Nitro-Pak, Yurika Foods, SI Outdoor Food & Equipment, Phoenix Systems, Sierra Surplus, or Survival Center for these types of foods. These companies sell other products and can switch from one food supplier to another if one goes out of business. A number of the freeze-dried foods are finding their way to the supermarket as well (instant soup being the most widely available at this time); it may soon be possible to purchase freeze-dried or dehydrated foods directly from your local grocery store.

New US military-style military rations are also a good source of long-term storage food. Some is actually freeze-dried food packed in containers which can be used to eat out of while others are packed with the water in them. The water-packed rations don't store for as long of time as the freeze-dried food does. Be sure to purchase either type of military rations from reputable dealers of surplus equipment so that you won't be getting out-dated food or "boot leg" rations. Good sources of these foods is Sierra Supply, Phoenix Systems, and Brigade Quartermasters.

Avoid purchasing surplus civil defense food which is REALLY outdated since it was probably packaged back in the 1960's. The only exception to this would be the candy (which can't go bad but is usually rather strange tasting).

Salt, sugar, honey, and sugar candy will keep forever if they are carefully packed so that moisture can't damage them. Lasting nearly as long are dried beans, corn, soybeans, grains, etc., IF they are kept cool and dry; while it would seem these would have a storage life little longer than dried foods, in fact it is much longer since the raw foods aren't cooked or otherwise processed to preserve them. (Dried corn has a shorter shelf life than the other grains—JUST several decades.) The only concern is to keep the kernels from being eaten by rodents or insects; probably the best and easiest way of doing this is purchasing the kernels packed in nitrogen with sealed containers.

These unprocessed foods also offer a very good buy since so little work is needed to package them. Good sources of nitrogen packed, unprocessed grains and beans are Nitro-Pak and SI Outdoor Food and Equipment. Their grains and beans are packed in tough plastic buckets (which can be stacked).

Even cheaper to purchase are grains and beans which have been processed but are not stored in containers or nitrogen. A good source for these is a local farmers' co-op in agricultural areas; be sure to specify that the grain or beans are for eating so that you'll not receive some that are treated with dangerous chemicals (for killing insects after planting). For those who aren't in such areas, it is possible to purchase large "packs" of hundreds of pounds of wheat, corn, pinto beans, soy beans and the like from Preparedness Products (cost is around $100 plus shipping charges—about 2-3 cents per mile from Utah—for around 500 pounds of grain or beans). The beans and grain are shipped in bags; they must be repacked in containers which will protect them from insects and varmints. But this translates into a big savings over pre-packed grain and beans. Too, the wheat is treated for insects and might be packed right into containers without problem (though, ideally, it would be packed in containers along with some dry ice—usually available locally—to drive out the air in the container so that insects can't live in it after it's sealed).

Of course the grain or beans must be processed before you can eat them. Beans are pretty simple; boil them and make soup. Wheat is a problem; while you can boil or parch grain and eat it whole, this practice will eventually lead to sore gums and teeth. A better route is to grind the grain and use it as flour. Besides making it easier to eat, more conventional baking and cooking can be done with flour.

To grind the grain, you need some sort of milling device. Probably one of the best and least expensive hand mills is the Corona grinder but is a little hard to find. If you can't find one with some of the survival companies listed in the appendix of this book, try the hand mills available from Nitro-Pak, SI Outdoor or the Survival Center. Whatever grinder you get, be sure to get a mill with a metal grinding wheel; stone mills put a little grit into each lot of grain that goes through them so that you'll eventually ruin your teeth if you have a steady diet of stone-ground grain.

If you don't have a mill, you might be able to beat or grind grain between two hard objects. In order for the grain to be eatable, try to break the kernels apart without getting bits of the grinder or other foreign matter in with the grain. If you're grinding grain this way, you may also find a thin metal screen is useful to separate the larger pieces of grain that need to be reground from the flour.

Whether you're using a mill or banging it apart, the finer the flour is ground, the less laxative effect it will have when you eat it.

The final group of foods you'll need in a storage program are any special foods (like baby formula or low-sodium food) for members of your family. The storage life of these can generally be found by the date marked on their containers or will have storage lives similar to those of the other foods listed above.

Regardless of what foods you're storing, lowering the temperature they're stored at will extend their shelf lives. If you can allow the food to be cold during the winter and/or air condition it during hot summers, the food will have a much longer life. The rule of thumb is that for every 15 degrees Fahrenheit you allow the food to drop (below 70 degrees Fahrenheit), the shelf life doubles. If, for example, you store your food at 55 degrees, you can double all the shelf life figures listed above.

You can get by with a lot less food than you normally eat if your activity is limited (as it will be if you're in a fallout shelter). Under such a circumstance, an adult can get by on 2,000 calories per day (ideally, you'll have a diet mix of somewhere around 15% protein, 55% carbohydrates, and 30% fat). For short periods of time you could even get by with a lot less—but your body would start to suffer and exposure to fallout and stress will already be putting a strain on your health. Don't try to just get by. Especially important is to get enough protein so that your muscles don't deteriorate.

(If some of your food supplies in sealed containers become contaminated by fallout, they would still be safe to eat. Radiation from fallout would not harm food in sealed containers. Therefore, provided you carefully "dust" any cans or other containers before opening them, the food would be safe to eat.)

Somewhere down the line, you'll have to leave your shelter and start raising food. Even if you could store enough food for years, chances are good you'd still need to be able to grow your own food if you're to survive for more than a short time. Your food storage plan is useful for getting you through the bad times; it would be impossible to store enough food to last out your lifetime.

When you start raising your own food, three things which will make your cooking and preserving chores easier are salt, spices, and seasonings. You should store these in large amounts since they are ideal for barter and may be impossible to find or create in many areas following a nuclear war. If you can't find salt in your area, store a lot of it; a person needs about 1/2 tablespoon (1/4 ounce) per day. While much of the food purchased from stores is over salted, that wouldn't be the case if you were raising your own food. Salt is being sold at very low prices now. Don't fail to stock up.

The amount of seasonings you store is a matter of taste (pun intended) but don't skimp on them. Food without seasonings can be very unpalatable. Spices are used for preserving food as well as for seasoning it. Study some of the books listed below to help you figure out what you need for your own personal storage program.

Food storage can carry you only so far following a nuclear war. Eventually, you'll either need to be able to produce your own food or have skills which can be bartered for food. Of the two, the first is considerably more secure.

A problem you would face in producing food the first few years following a nuclear war is the increased amount of ultraviolet radiation which may result from damage to the ozone layer when nuclear fireballs go through them. According to the National Academy of Sciences' 1975 study on nuclear war, possibly 30 to 70 percent of the Earth's ozone layer would be destroyed. According to the study, the ozone layer would regenerate itself in several years; but the first years will be pretty hard on plants.

You can get around this and other weather problems by having a year's worth of food; this would allow you to plant in a less harsh environment during the second year following a nuclear war. Another "ace in the hole" would be to have a good stock of extra vitamin/mineral supplement tablets which could take up the slack in a diet that was not all that balanced because your "green thumb" failed in a crop or two.

The time will come, however, when you'll have to produce or trade for food. Trading gets problematical and forces you to depend on luck to find someone that's growing enough to trade with you. A better bet is to grow your own food just as your ancestors did. While you may not have the expertise or experience they had, you do have an edge of them: you can take advantage of new technologies and have access to well-written instructions. But you should start learning how to produce food right now, not after a nuclear war has ruined your chances of taking advantage of what the 20th Century has to offer you.

Here are some important things to know when thinking about growing food in the aftermath of a nuclear attack:

Fallout levels sink to a safe level very quickly even in areas of maximum fallout. Fallout tends to stay on the surface of undisturbed soil; in areas with major contamination, the top soil—along with the fallout—could be removed and the land used for gardening (or full-scale farming if you had access to heavy earth moving equipment so that you could scrape off the top soil). Removing the top 2 inches of dirt on a flat surface will remove up to 99 percent of the contamination (with a rough or previously tilled surface, removing 2 inches will only remove up to 60 percent of the fallout). Removing sod or heavy hay-type covering from the ground will also remove from 30 to 90 percent of the contamination.

(Another route which could be taken for large-scale farming is to plow under the contaminated dirt so that the fallout is below ground. This allows plants to obtain nutrient from the soil while the earth acts as density shielding to lower the radiation to levels that will not harm the plants or the people working the soil. For this to be effective, the top soil must end up at least 18 inches below the surface. This method will reduce contamination by up to 50 percent.)

If you are forced to use plants which have been contaminated by fallout, or your garden is contaminated by fallout from a second wave of nuclear attacks, you can still eat the produce from the plants if you carefully peel and clean the plants. Fallout will be removed with the outer layers of plant material if you do this. The same is true of plants you may find in foraging. If you can peel and wash a plant off, you can usually eat it without ingesting a dangerous amount of fallout. (Be sure to decontaminate your hands following this work.)

When growing plants in areas where fallout has contaminated the dirt, the principle form of contamination you need to be concerned with will be Strontium-90. This isotope is similar to calcium and will be absorbed by the plant if calcium is not readily available. Therefore, increasing the amounts of calcium-based material in the soil will lower plants' Strontium-90 intake. Lime, gypsum, and many fertilizers will all work for this.

For the same reason, land used for vegetables which are high in calcium should be carefully decontaminated. Land that can't be easily decontaminated can be used for growing crops that are low in calcium content. (Check some of the books listed below for information on calcium content of food.)

Now is the time to practice growing food. Waiting until the pressure is on to produce and where a small mistake could spell your doom is not a wise plan. Since you're more interested in producing food than using your garden for a recreational past time, you must be sure to use methods which take a minimum of work and time while creating a maximum of produce for your efforts.

Perhaps the best methods of maximizing food production are greenhouse gardening (and you can use clear plastic sheets rather than glass), hydroponic production, and intensive gardening.

The easiest for most people is intensive gardening. A series of excellent articles is given in the June, July, and August 1984 issues of the AMERICAN SURVIVAL GUIDE magazine. This three-part series gives information on this method of gardening which uses mounds of raised earth to grow thick clusters of plants rather than using rows of widely-spaced plants.

By using the raised mounds of earth, the gardener doesn't have to stoop as much when working and can also reach more plants for weeding and tending them. Paths are used to walk on as well so that there are fewer wasted areas because the plants can be closely spaced in their beds. Intensive gardening allows more food to be produced in a smaller area than conventional growing methods and also minimizes water, herbicide, and pesticide needs.

Hydroponics uses water and "synthetic" dirt substitutes like gravel and plastic pellets to grow plants. Because dirt isn't used, a lot of diseases that attack plants through the soil are prevented. An excellent book on the subject is HYDROPONIC FOOD PRODUCTION by Dr. Howard M. Resh (current price for this book is $14.95). Another good book is HYDROPONIC GARDENING by Raymond Bridwell; this 224 page paperback is available from Atlan Formularies for $5.

Both hydroponic and intensive gardening can be enhanced if adapted to a greenhouse-type operation. With the addition of a heat system to the greenhouse (and perhaps some artificial light in northern areas), crops can be "staggered" so that production of fruits and vegetables becomes year long rather than seasonal. A greenhouse is ideal for several other reasons as well.

One consideration is that a number of insects and rodents which may attack your garden can survive high levels of radiation while the larger animals that prey on them can't. So a greenhouse that can keep pests out might be a necessity for gardening. Plastic used for the greenhouse walls and ceiling will cut down on the ultraviolet radiation as well so that plants that couldn't survive in the open can be raised under plastic.

Since the National Academy of Science's 1975 study mentioned above also concluded that damage to the ozone layer could lower the Earth's temperature by a few degrees (or more if the Nuclear Winter proponents should be correct), a greenhouse would enable you to maintain temperatures which allow your plants to grow; a wood stove would enable you to extend your growing season while using easily obtained wood for fuel.

Thin sheets of plastic can be used to create a temporary greenhouse which will last one or two growing seasons. Rolls of plastic suitable for such use are available from most lumber yards (the material is used to waterproof concrete floors or cover lumber being used at outdoor construction sights). Some of these plastics will deteriorate with exposure to ultraviolet light. If possible, ask for the type of plastic used for greenhouses as this is treated to resist ultraviolet light and will last several seasons with extra care.

For a more permanent set-up, corrugated fiberglass sheets are more ideal and—with care—will last a number of seasons (be sure to get sheets which have a maximum resistance to ultraviolet light). Fiberglass sheets are available (along with the other building materials you'll need to frame your green house) at your local lumber store. Two good sources of supplies for your greenhouse, as well as reference materials, are Charley's Greenhouse Supply and Mellinger's.

It would be wise to start your garden—or even add some sort of greenhouse to your home—right now. This will allow you to start developing your green thumb and will also give you a source of food for eating and even canning to add to your storage food stocks.

An excellent book which describes ways of storing foods—so that you'll be able to eat year round rather than just during the growing seasons—is Kurt Saxon's SURVIVAL FOODS, PLUS available from Atlan Formularies for $15. This book gives some excellent "low-tech" procedures used in the 1800's which enable you to preserve food without special equipment or chemicals. The methods used for preserving everything from eggs to vegetables to meat are all exhaustively outlined. It's one of those books that I consider essential. Also useful for your food processing work are a good supply of matches (you can't have too many), a mechanical alarm clock/timer, and a cooking thermometer.

If you can't use a greenhouse to grow food following a nuclear war, there are some plants which are more resistant to ultraviolet radiation. The best are wheat, soybeans, rye, barley, alfalfa, and corn (all of which are excellent sources of nutrients and have long storage lives when dried). Though the extra ultraviolet light during the year following a nuclear war will stunt these plants' growth somewhat, they will still produce food for you.

When possible, garden seeds should be purchased which are NOT hybrids. This is because if you grow hybrids, you'll be in great shape the first year, but the seeds you get from the hybrid plants will produce a number of different varieties of the plant the next year or may not even grow or bear fruit. Several good sources of seeds are the Cross Seed Company, Nitro-Pak, Seeds of Survival, and Vegetable Seed.

Just as your food in storage needs to be rotated to keep it in good shape, so, too, do your stocks of seeds. Otherwise, more and more of the seeds will fail to sprout when planted as years go by. Ideally, seeds should be replaced every year. Rotating the seeds isn't a problem if you're growing a garden—another good reason to be doing that now.

Fruit trees would be a possible source of food IF you were in an area of relatively low fallout. While evergreens (softwoods) are very sensitive to radiation, deciduous trees (trees which shed their leaves each fall) are much less sensitive. Total doses of radiation ranging as high as 2,600 to 7,700 roentgens would kill only half the deciduous trees. By keeping surviving trees watered and free from parasites (since the tree's ability to fight off diseases will be weakened), trees could be kept and used as a source of food as well as firewood.

Whether you're growing a garden or guarding fruit trees, the "enemies" you'll face will be legion; insect pests, rabbits, mice, and rats will be striving to undo your ability to raise and store food. Many of these animals have a high resistance to radiation and—in most cases—their natural enemies have low resistance to radiation. There are several ways to fight these pests, and you must do it successfully if they are not to eat you out of house and home.

Chemicals are often useful in fighting various types of pests. There are two types to consider: those that repel pests and those that actually kill the animals. Repellents are usually safer, especially when dealing with garden pests. Therefore you should use these first.

(Some insects are also dangerous to you. Many of these, including flies, mosquitoes, and ticks, can be countered with a good insect repellent. The best two chemicals to check for in repellents are N,N-diethyl-meta-toluamie—"deet" for short—and ethyl hexanediol. Both are expensive but work much better than others.)

Several natural-occurring chemicals act as repellents to insects and can be used to keep insects out of your living and gardening area. While not as effective as commercial repellents, they may be more readily available during an emergency. These chemicals include clove oil, pepper (of all types), camphor, bay oil, and cucumbers (which are especially effective in repelling cockroaches). To prepare these, just grind the plant materials (singly or in combination), add some water or alcohol to the mix, and spread it where you don't want six-legged enemies to be walking (winged insects won't be repelled too much by these, unfortunately).

You'll need more than repellents; some insect pests you'll want dead. While household insecticide aerosol sprays will often do the trick, they don't have as long a shelf live as one might hope for. Nevertheless, you'd be wise to have some cans of Raid (or similar products) in your survival stockpile. Such chemicals would be especially useful during the first year following a nuclear war.

One insecticide with an extremely long shelf life is Chlordane. While this currently can't be purchased in most commercial stores, it is available to farmers and can be purchased from mail-order sources catering to farmers. One such company is the Omaha Vaccine Company which sells a 1/2 gallon of Chlordane (72% solution) for $29. To use this chemical, it should first be mixed with water. One half gallon of 72% chlordane when mixed with proper amount of water creates 46 gallons of insecticide. (Do NOT be tempted to use the chemical as an everyday pesticide; a number of insects have been developing a resistance to it—which is one reason it is currently banned; use it only for emergencies.) There is also some medical evidence that chlordane causes long-term health problems so don't contaminate your garden or house with this material. Like most other insecticides, in high concentrations it is poisonous to human beings so observe all precautions when using it.

When using liquids you've concocted or chlordane, a garden pump spray dispenser is very good for putting the poison where you want it. These are available from the gardening section of most hardware stores.

A number of crawling insects can be killed indoors with borax powder. This is commonly available and has an infinite storage life. Borax powder is only mildly poisonous. But many insects, like ants and roaches, spend a lot of time cleaning off any material that sticks to their feet. If borax powder is in areas where the insects travel, they'll gradually ingest more and more borax off their feet when they clean them until finally the poison kills them. Be careful where you spread borax powder since it is poisonous if ingested to people, too. And do not use it outdoors in a garden where water will wash it into the soil.

Other natural chemicals which will kill a number of insects are to be found in citrus fruit peelings (especially oranges), nicotine, and caffeine. If you can grow any plants which produce these, they are very good "insecticides." Soap and water are also quite deadly to many insects. Mix any of these up and spray them onto infected plants or insect colonies.

Traps are useful in dealing with many pests. The big plus with traps is that they keep you from having to use dangerous chemicals and can even allow dead pests to be used as fertilizer since they won't contain any dangerous insecticides or other poisons. (Some pests can also be eaten by livestock like chickens.)

Flies are obnoxious and can contaminate food, especially indoors, and often spread diseases. One good trap for catching flies can be created with an empty, clear quart bottle with a small mouth (beverage bottles work quite well). Partially fill the bottle with water—adding a little soap or detergent will increase the effectiveness of the trap—and place it on its side so that the mouth of the bottle faces to one side and the water remains in the lower half of the bottle. Bait for flies can be rotten meat or the like (don't use sugar or honey since you'll attract beneficial insects like honey bees). Place the bait inside the mouth of the bottle.

As the flies eat the bait and get full, they try to take off. About two thirds of the time, they'll take off into the bottle rather than through its opening. When they crash into the clear glass, they drop into the water and, in a short time, drown. As the flies rot in the water, they attract more of their kin so that the traps run themselves after they are started.

Another type of fly trap can be made with a wide-mouthed bottle and a paper or wire cone. The cone is placed in the baited jar with the cone point down. A small hole is located in the point of the cone. Flies enter the jar through the cone and become trapped when they try to fly off (they can't seem to hit the hole).

Fly paper is an old way to catch flies but is a bit of a hassle to create. Rosin (often to be found on pine trees) works well in making fly paper. Turpentine or linseed oil can be used to dissolve the rosin and the mixture can be painted onto paper or any other surface and left to dry to a tacky surface. Here are two old fly paper formulas: 150 parts rosin, 50 parts linseed oil, 18 parts sugar or honey; and 10 parts turpentine, 10 parts rosin, 1 part honey or sugar. (Because the honey or sugar used to bait the paper will attract beneficial insects as well as flies, the paper should be used indoors.)

Water traps can also be created to kill larger pests like rats and mice. The idea is to cover the surface of the water with enough small floating material to make the surface appear to be solid (styrofoam, straw, etc., will all work to cover the surface). Bait is placed in the center of the water to attract the rodents. When they try to walk on water to get to the food, they discover their lack of faith and soon drown.

It's a good idea to create some sort of obstacle to keep the rodents from swimming to the side of the container and climbing out. As with the fly traps, adding detergent to the water will greatly enhance your trap's abilities to kill mice and rats.

A similar mouse/rat trap can be made from a large ceramic or metal container. A mouse- (or rat-) sized hole is placed in the upper side of the container and the container is buried in the ground so that the hole is even with the surface of the ground. Bait is placed inside the container and the mice or rats will fall into the trap while trying to locate the bait.

Buy some of the old standard mouse and rat traps to use, too. While some rats are smart enough to avoid these, you'll still catch a number of them with these traps and be able to cut down on their numbers.

There are a number of other ways to control small garden pests. If possible, get a copy of the August 1984 issue of the AMERICAN SURVIVAL GUIDE and study Henry Lee's article, "Low-tech Pest Control."

A number of insects and animals are natural enemies to many of the pests you'll have trouble with. Many of these natural enemies can be transported into your garden or other areas to help cut down on the pests. When you're out foraging, watch for beneficial insects, toads, non-poisonous snakes, etc., bring them back into the area of your home and garden. These animals will quickly aid you in cutting down the numbers of pests.

About 99 percent of all insects are beneficial. So don't kill insects indiscriminately and—if you're not sure as to whether or not an insect is harmful—don't kill it. Among the insects worth "cultivating" are the praying mantis, lady beetles (or lady bugs), assassin beetles (cog or wheel bugs), ant lions, aphid lions, carrion beetles, and fireflies. Some insects like butterflies and bees should also be left alone as they are essential for pollinating many plants.

Where possible, use screening, mosquito netting, plastic sheets, etc., to keep pests out of areas you're living or gardening in. With intensive gardening, it's actually possible to screen in an entire garden and greatly reduce the insect damage done to it (BUT, remember that some insects are necessary to pollinate plants to produce fertile seeds. Don't overdo things.)

Wild dogs, rabbits, raccoons, opossums, etc., can all create havoc in a garden. During the best of times these animals may be aggravations. During the aftermath of a nuclear war, they could spell your slow death by starvation. Fencing is an important step with gardens toward keeping larger pests out of an area. Barbed wire and chicken screen are probably the most effective of fences though simple board fences might be improvised with scrounged materials.

Be sure to wrap the base of fruit trees or small, newly planted trees from the ground up to several feet above the surface of the earth with heavy layers of foil, aluminum screening, or other material. This will keep hungry rabbits from girdling and killing your trees and also prevent snow burn (from reflected sunlight) during the winter in northern areas.

Small-caliber firearms can be effective in dealing with larger pests. They can also be very wasteful of both time and valuable ammunition. Thought must go into the use of firearms in killing pests.

Wild dogs as well as rabid animals might be quite common in areas with minimal fallout. Such animals do call for the use of a pistol or small caliber rifle if you're to be adequately protected. An assault rifle (which we'll look at later) can also double as a very effective varmint rifle for dealing with larger pests. Using it for such a purpose will also give you needed practice.

The catch with most firearms, however, is the noise created by their discharge. Such racket may create attention which you don't want. There are several solutions to this problem. One is the use of "squib loads" in your rifle or pistol. A squib load is one that has a very small powder load so that the retort of the rifle is a lot softer than normal. The only problem with squib loads is that they don't cycle the action of a rifle and require reloading equipment as well as a lot of time to perfect (I've outlined the techniques for creating squib loads as well as making your own ammunition in my book, COMBAT AMMUNITION, available from Paladin Press for $19.95).

A better tool for pest control is the .22 rimfire rifle. Probably the best—and certainly the least expensive—.22 cartridge is the .22 Long Rifle (LR). The real plus of a .22 firearm over the adapter is that a second shot is quickly available if you need one.

While the retort of a .22LR is far from soft, it doesn't carry nearly as far as that of a centerfire rifle. An added plus is that the .22 won't damage the pest much; meat and pelts are available if you haven't annihilated the animal with a heavy-caliber weapon. (Even if you don't plan on eating dogs or what-have-you in the way of pests, the meat could be eaten by some live stock, used for traps, make bait for fishing, etc., and the fur would be quite useful if tanned properly.)

The wide variety of .22 LR cartridges allows you to select a round suitable for dispatching medium-sized pests (high-velocity rounds like CCI's Stingers) to standard rounds for small animals.

AND, it is possible to shoot nearly silently with a .22 rifle. The secret is to use CCI's CB Caps. These are, in effect, commercial .22 squib loads; fired from a barrel of 16 inches or longer, the clatter of the hammer is generally as loud as the muzzle blast of the gun. This is because the powder burns completely in the barrel. The bullet of a CB Cap doesn't have enough velocity to use it on large animals (except, perhaps, with VERY precise bullet placement), but it is ideal for smaller pests from rabbit size on down within 30 to 50 yards. The action of .22 semi-autos has to be cycled by hand since the CB Cap doesn't have enough recoil to reload the gun; but this isn't too much of a handicap because of the minimal noise created by the round. CCI CB Caps can be purchased from anyone who sells ammunition; if a gun shop doesn't have CB Caps in stock, they can easily be ordered and cost only a bit more than standard .22 LR ammunition.

Adapter kits that turn centerfire rifles into .22's are also worth considering. Such kits are available for the Mini-14, AR-15, HK-93, and HK-91 (more on these rifles in a later chapter). These allow you to stay familiar with your combat weapon since the operation will be the same regardless of the caliber. The down side is that the kits cost about as much as a good .22 rifle and the powder residue from the .22's will create a lot of fouling in many combat rifles so that some extra care has to be taken in cleaning them. Because of these drawbacks, a lot of people would probably be better off purchasing an inexpensive .22 rifle.

Some excellent .22's are available on the market today. Some of the best are the Ruger 10/22; Marlin's 70, 70 Papoose, and 99; Feather Enterprise's AT-22; and Charter Arms' AR-7. I've found these rifles to be accurate and very reliable. (For the utmost in reliability with the AR-7, have a good gunsmith throat the rifle; the procedure is very simple to do and will cost only a little.)

Twenty-two pistols are harder to use in fighting pests but also easier to carry around when gardening or working. The best .22 pistol available is the Ruger Mark II.

Another useful tool for fighting pests is a pellet rifle. Like the CB Cap, these create very little muzzle blast so that you can keep a low profile if necessary. Pellet guns have advanced well beyond the BB gun you might have had as a kid. Modern pellet rifles fire lead bullets at speeds that approach those of .22 rounds. The big plus with pellet guns is that ammunition is cheap (air and a small bit of lead) and the rifle actually gets better with use because the parts wear in and function more smoothly. Maintenance is also low and rifles need be cleaned only once every thousand rounds.

A pellet gun kills by penetration. Momentum and pellet size aren't considerations; speed and accuracy are. Because of this, flat-shooting .177-caliber air rifles are more effective than their .22 counterparts. (A pellet traveling at a velocity of 500 fps is the minimum needed to kill a large rat or similar animal. To use the rifle out to 50 yards and still have this velocity, you'll need a gun with a muzzle velocity of 800 to 850 fps.)

Single-stroke spring-powered air guns are most ideal for target use but are rather heavy, tend to be expensive, and can't be left cocked for an extended time without ruining their springs. Because of this, they are less than ideal for "sniping" at varmints.

That said, two good rifles which are single-stroke, spring-powered, and have the required muzzle velocity to take out pests are the Beeman/Webley Vulcan II (available from Beeman's for $189.50); and the RWS Model 45 (available from Dynamit Nobel for $217). Chinese rifles are also becoming available in the US; these have low price tags while still having the energy to do the job. The only catch is that they may be slightly less accurate than European-made guns. Currently, Navy Arms offers an excellent AK-47 style air rifle for just $60.00. (Important: never fire an air rifle without a pellet in it; doing so will damage the piston.)

Newer air rifles made by Daisy work on the principle of compressing air with a built-in pump on the gun. These take a little longer to charge since up to ten pumps are needed, but they have the advantage of being able to be cocked for long periods of time (and, in fact, will have their valves last longer with a couple of pumps of air in them). They are also lighter and less expensive to make because the recoil isn't as violent as that of a spring gun; the low recoil also makes scope mounting simple because .22 rifle scopes will work on them and stay in place (this isn't the case with spring-powered guns which require a heavy scope that is hard to keep fastened and zeroed).

Among the best of these are the Daisy Power Line 856 (my favorite), and the Power Line 860, 880, 900, and 922. If greater accuracy is needed, a bit higher purchase price will give you the Daisy 920 (.22) or 970 (.177), both of which have a lot of power and more accuracy than most shooters can take advantage of. (The Daisy models are available in both the .22 and .177 bores so that the shooter can choose the caliber he wants.)

One big plus of the 856 and 880 .177-caliber Daisy rifles is that they can be used with BBs as well as lead pellets. While BBs aren't as accurate as lead pellets and lose their velocity faster, they also are made of steel; this means that they won't contaminate a garden with lead the way bullets or pellets will.

Another big plus is the cost of the Daisy guns: if purchased at a discount store, cost will be about half to a third of that of the spring-powered guns.

Air pistols don't have the velocity to make them useful at as long a range as the rifles. However, they are a lot easier to carry around. Two of the best spring-powered guns are the Webley Tempest and Hurricane models. Both are available from Beeman's for less than $100. Daisy's Powerline 717 is a really good buy and requires only one pump to fully charge it; it is very accurate and gets 306 fps with standard .177 pellets so that it is capable of close range varmint shooting. (It should be noted that the manufacturer recommends that, unlike the pump up rifles, this gun not be left charged for more than an hour before discharging it.)

If you're planning on purchasing a .22 rifle, then deciding whether to get an expensive spring-powered air rifle or purchase a number of CB Caps is a tough decision. For the price of a good air rifle, you could buy a wealth of .22 CB Caps and achieve the same degree of nearly silent killing power with your .22 rifle; and you'll have quicker follow-up shots since cycling a new shell into the chamber of a .22 is a LOT faster than cocking and loading an air gun. But, after several thousand rounds have been fired, even the expensive air rifles start to come out ahead (and the inexpensive Daisy guns are always out ahead—especially if BBs are used). And you might be able to cast your own lead pellets for an air rifle; reloading .22 cartridges is nearly impossible at best. Since you'll be needing such silent shots over years of time, the air rifle may be a better choice. But do some careful figuring before you go with one or the other.

Whether you use CB Caps, pellets, or even BBs, remember that all are capable of injuring a human being; don't get careless with them just because they don't "sound" dangerous.

A scope—whether on a .22 rifle or a pellet gun—allows for the quick accuracy you need for small targets. While this may take some of the "sport" out of hitting pests, it will save a lot of time and ammunition and will also allow you to quickly train a novice to use the weapon since aiming a gun is one of the hardest parts of mastering it.

Sometimes, you may wish to scare off pests rather than kill them. For example, the family dog—digging in the garden—hardly warrants the "death penalty" for such an offense. But it would be nice to discourage such activity. In such a case, felt pellets are available for air rifles which allow you to inflict some pain without creating excessive injuries (just don't hit the animal's eyes).

Plants can't easily supply you with all the nutrients you need. Meat, or animal fat from products like milk, cheese, or eggs, is necessary to enable your body to synthesize the complex molecules needed to live. While some all-vegetable diets can come close to being complete meals, producing the range of plants needed for such a diet during the aftermath of a nuclear war would be very hard to do. But a largely vegetable diet supplemented with eggs, milk, or animal fat would make it possible for you to survive and maintain your health.

Hunting? Again, you can't hunt what isn't there. Fishing? Possibly IF you are near a river or lake which wasn't contaminated with enough fallout to kill or contaminate its fish. Insects? If you aren't squeamish, this would probably be the most reliable "wild meat." Insects are highly immune to radiation and are rich in protein and amino acids. But most of us are not capable of eating such fare even if starving.

So you'd better plan on raising animals on your own.

Raising animals is a complex proposition. Generally, the smaller the animal, and the more quickly it reproduces, the easier your job will be and the more food you'll be able to produce.

Protecting animals from radioactive fallout is little different than protecting yourself. Likewise, raising food for them is basically the same process as that of producing your own food with the plus being that animals aren't so fussy about what they eat.

As with plants, ultraviolet light will be a problem for animals. Either you'll have to keep the animals out of the sunlight or devise some way to protect their eyes.

Your work will be easier with some animals. While sheep and cows are about as resistant to radiation as people (400 to 500 REMs will kill half of any given population of them), chickens have a tolerance that's much higher. In fact, a dose of 900 REMs will only kill half a chicken population. (Swine have a lethal dose factor of 50 percent for exposures of 640 REMs and horses, 670 REMs.)

Chickens also are small and eat almost anything—including each other if you're not careful—which makes them quite ideal for survival purposes. Chickens also produce eggs so that you can have your flock and eat, too. The ABC'S OF POULTRY RAISING from Dover Publications (for $4.50 postpaid) is an excellent place to start if you're interested in raising chickens. (Guinea fowl are also said to be as good or better than chickens for producing eggs and meat; the major plus with these birds is that they are better foragers than chickens. However, much less "how to" information is available about them.)

Rabbits have a lower toleration for radiation but also are small and eat a wide variety of food. And multiply like... well, rabbits. Provided they are carefully cared for, two bucks and eight does could supply you with 800 pounds of meat and 200 rabbit skins per year! A good how-to book about raising rabbits is Bob Bennett's RAISING RABBITS THE MODERN WAY. It's available from Atlan Formularies for $6.95.

Whatever animals you may have, processing or washing the food they eat (if this is practical) will help to reduce their intake of fallout which causes burns to their intestinal track just as it does with human beings.

While hunting may not be too practical for supplying all your meat needs, you may encounter untended farm animals or game and need to eat it in order to survive. How safe is the meat from an animal that could be contaminated by fallout?

Animals which may have ingested fallout but have NOT become sick from radiation exposure are safe to eat if you follow a few precautions. Just be sure to remember that the animals could be used for breeding purposes if they are domesticated or could breed in the wild to allow you to harvest game through hunting later on.

If it is REALLY necessary to kill them for food, and the animal still looks healthy, here's how you keep from ingesting contaminated meat. Some parts on an animal's body absorb and store more radioactive isotopes than others. This means you can avoid high concentrations of contamination by discarding the most contaminated organs. The parts to avoid are the thyroid glands, kidneys, liver, and meat next to the bones as well as the marrow in the bones. Muscle meat would be safe to eat. (Remember to discard the dangerous organs where they won't contaminate water or crops.) Because of the animal's reduced resistance to disease, be sure to cook all meat very thoroughly to kill any organisms which may have been multiplying in the animal. Eating a rare piece of meat could give you a serious case of food poisoning.

If an animal is acting sick, do NOT slaughter it. Though the meat may not be contaminated with radiation, the animal is sick. This probably means that it has some sort of disease-causing virus or bacteria brought about by its lowered resistance because of excessive radiation exposure. Eating meat from such an animal could give you food poisoning since cooking the meat would only kill the bacteria or virus but not the toxins (which are what made the animal ill in the first place). But a sick animal may be salvageable. If you can nurse it back to health, it can be used for breeding or food later on.

Because of the reduced ability of animals to ward off diseases, animals which are sick should be separated from others in a flock or herd. Otherwise, any contagious disease will quickly spread through the entire animal group. Proper hygiene and careful disinfection procedures will also increase the likelihood of the animals' survival.

There are two useful books that will aid you in raising farm animals: THE OWNER-BUILT HOMESTEAD by Barbara and Ken Kern (printed by Charles Scribner's Sons, NY—check your local library or book store) and FIVE ACRES AND INDEPENDENCE available from Dover Publications for $4.95.

You should also be purchasing the tools you'll need for gardening/farming and becoming used to working with them. Bear in mind the fact that there will be no gasoline to power anything. Among the "essential" gardening tools you will need are a spade, hoe, rake and wheelbarrow. A hand plow would also be very useful.

Some sort of food storage plan is essential and must be coupled with an ability to produce your own food if you are to survive a nuclear war and live in its aftermath.

WASTE DISPOSAL

Whether in the best of times or the worst of times, disposal of human wastes is a matter of life and death. Many historians feel that the lowly sewer line and waste treatment plants have done more to extend human life expectancy and have saved more lives than better nutrition, wonder drugs, or better medical know-how.

A witch's brew of deadly bacteria, viruses, and poisonous chemicals, human excrement must be dealt with properly in a post nuclear war situation if you're to survive for long. Most people carry, inside their gastrointestinal tracts, many deadly "bugs" which are, fortunately, kept in check by the body's defenses. Once these bacteria are free of the human body's defenses, however, they become free to multiply in human waste. Adding to the problem, human excrement also attracts flies, cockroaches, rats, and other vermin which can carry dysentery, typhoid, paratyphoid, cholera, and plague. Consequently, improper waste disposal will almost guarantee an outbreak of a deadly disease. (Unfortunately most vermin have high resistance to radiation which would make them extra dangerous in a nuclear war situation.)

Additionally, paper wastes and trash—even if clean enough not to be a health consideration from the standpoint of the bacteria or viruses on them—can furnish a home for vermin. Such trash could also attract unwanted human attention in the aftermath of a disaster. Looters or other undesirables could be alerted to your presence if you've created a mound of empty cans and other garbage outside your shelter.

The good news is that dealing with waste is not complicated. If you understand a few basic principles, take a few precautions, and carry out proper procedures, you can deal with potentially dangerous wastes. The basic principle is simple enough: keep waste and the pests it can attract away from food and water supplies.

If paper wastes and garbage build up, the only solution may be to burn the trash as soon as possible and the material which can't be burned must be buried or stored in abandoned buildings or the like. This is far from ideal but might be the only way to head off the health problems which would quickly develop as rodents and insects found homes in the garbage. If you are forced to burn trash, you should remember that the fumes and smoke given off through the burning of plastics can be quite dangerous; but the deadly fumes would be less dangerous than the health problems which are created when garbage builds up.

Perhaps more of a problem would be created by the human excrement which would be generated by a disaster which disrupts utilities without killing off a large segment of the population.

If you're living in an area which uses a sewer line connected into a sewage treatment plant, chances are good that, during a war, the pumps moving effluent (the polite word for liquid human wastes) and sludge (the heavier solid wastes) will become inoperable. That means that those in high areas of town may still be able to use the sewer system for a short time—until things get clogged up. Those in low-lying areas—or the bottom floors of high rises—may see their sewers back up into living areas. If YOU are currently the "low man on the totem pole," then you should give some thought as to how to disconnect your sewer line from your system.

One of the good news/bad news things about all this is that most city water supply systems will also vanish during a nuclear war so there will be less water flowing into the sewage system. This will keep large amounts of water from flooding into non-functioning sewers and backing up. This might also mean that some inoperable sewer systems might still be used for dumping liquid wastes into for a short time following the beginning of a nuclear war; however, don't plan on using this stop gap method of dealing with wastes.

While you're in a shelter, you'll have to "camp out" in it and store waste as it builds up. Perhaps the most important consideration in such a primitive system is how long it will be needed. As time goes on, this system becomes more dangerous since containers for holding waste become scarce as well as deteriorating to the point of leaking. Because a protracted nuclear war could mean staying in a shelter for months in areas of high fallout, some thought to other systems of disposal would be in order if you're living close to major targets.

Garbage can be stored in empty food containers. Even regular cans can be used for storing garbage. By saving the lid, the container can be filled with garbage, the lid replaced, and the can sealed shut with masking tape or duct tape. Take care when storing these containers that the seals on them aren't disturbed; tape will tend to come loose over time. Having the "ripe" garbage get loose would be far from ideal! Plastic bottles can also be used for storing garbage. Don't use glass containers to store garbage since the glass is easily broken—with disastrous results if it contains "ripe" garbage.

Non-liquid wastes like paper, dirty rags, paper plates, dipper wipes, etc., can be placed in plastic garbage bags (just be sure rodents or stray pets can's gain access to them).

Once the shelter can be left for short periods of time, these cans of garbage and trash sacks should be buried. This material should be buried downhill from your well or other water source (so that it won't contaminate them) and be under enough soil so that it won't be dug up by animals. You should also give some thought toward keeping this trash out of areas which may be used later for gardening or even farming in a post-disaster period.

While the shelter is occupied, the "rest room" can be crude and still be usable. But it must work efficiently. A pail, bucket, or a portable chemical toilet is simple to create or purchase and—with care—would get you through a major crisis. As mentioned before, the "weighty" part of excrement is actually water, if you can divide your excrement disposal into liquid and solid wastes, storage becomes greatly simplified. Therefore, it is wise to have separate facilities (i.e., buckets) for urine and feces.

If possible, a large hole could be dug outside a fallout shelter and the excrement bags stored in the hole until they can be buried following an end to the nuclear war or other crisis. Great care should be taken to keep this hole free of vermin. Use of insecticides and a tough cover over the hole are a must.

Make such a pit deep and use the dirt from it to make a trench around the hole so that rain water can't drain off the soil surrounding it and into the pit, causing it to overflow. If you're using such a waste pit in conjunction to a nuclear fallout shelter, one of your first tasks when you can finally leave your shelter should be to bury the waste from the pit so that it won't become a health hazard or a breeding ground for pests.

If it's not possible to use such a pit outside your shelter, it would be possible to use a covered garbage can for such a purpose; be prepared to bury the whole pail in the post-nuclear war period when you can exit your shelter.

Urine and water used in cleaning and food processing is initially relatively low in dangerous bacteria (as compared to feces) and could be stored in empty containers which were originally used for emergency water supplies. These liquids could also be transferred via a hand pump or—more ideally—by gravity action into a cesspool or sewer system (as outlined below). Since this will be the bulk of your waste problem, thought should be given to how to deal with this liquid waste. If these liquids are to be transferred outside the shelter area, the sooner the transfer is made, the fewer the bacteria which will have grown in the liquid. Once the liquid waste has been stored for any length of time, it becomes very contaminated.

Buckets or barrel "toilets" should have a seat made or purchased for them. Generally the simplest route is to go to a hardware store and purchase a toilet seat but, in a pinch, the seats can be removed from household toilets with a pair of pliers.

Chemical toilets are better than make-do buckets and pails but, ideally, should be used only for liquid wastes while plastic bags are used for feces. Chemical toilets do require extra space for the chemicals and water that they need, however. So if space or water is at a premium, a pail is a better bet. One good portable system is the "Porta-potti" marketed by Sears and some camping stores.

To keep smells down in your pail, bucket, or "Porta-potti," it's possible to use the chemicals designed for chemical toilets to treat excrement. Companies selling the portable chemical toilets also sell the chemicals for them. You can also improvise your own chemicals from formaldehyde and methyl alcohol (available at almost any drug store); rubbing alcohol by itself can also be used. With the feces pail, powdered lime or chloride of lime may be added to the excrement to keep bacteria growth under control; wood ash or soil will work for this purpose in a pinch. In the cramped space of a shelter, some thought should also be given to privacy. A shower curtain or screening of some sort is important. Air fresheners containing alcohol will also help keep both smells and bacteria out of the air.

Venting the "toilet bucket" will help keep odors down. A separate vent pipe (or even a garden house) leading down to the bucket would be best but placing your "bathroom" near the exhaust vent of the shelter will also work. This is important, too, with chemical toilets; while the chemicals for them help keep smells down, the units are not odorless despite the ad hype.

If there is a well or other source of water in or near your shelter, it would be possible to use a standard flush toilet in a shelter if you went to some extra work and added a septic system—or even a crude cesspool—for the stool to drain into. This would be a big step up in waste disposal and a moral booster in a crisis.

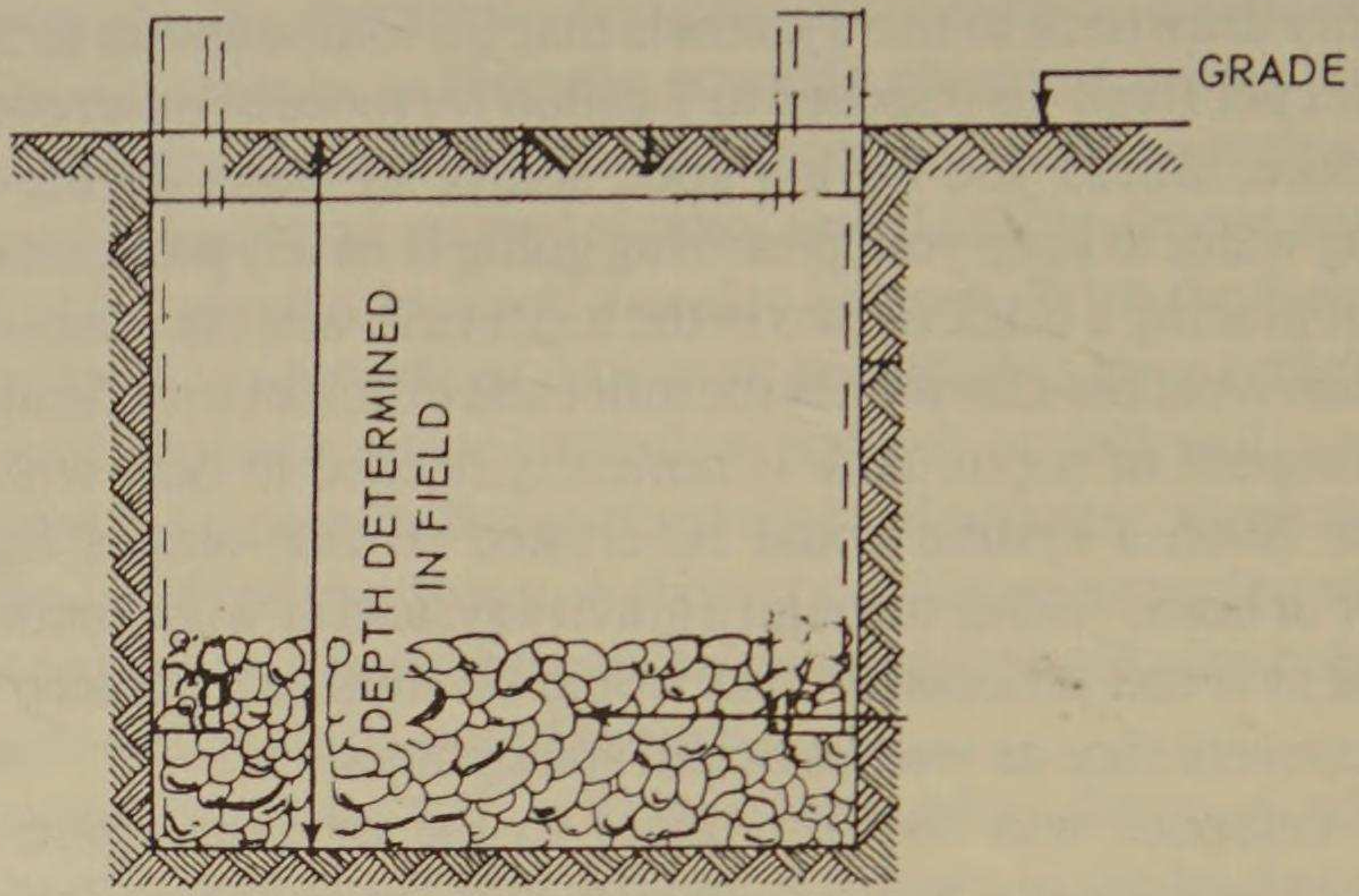
Standard toilet tanks can be filled by carrying water to them and placing the water in the stool's tank. Because stools have an automatic valve in them which turns water on and off, a simple siphoning system can be created in nearly any home with indoor plumbing. All that is needed is to shut off the supply line coming into the house (assuming a city water system is being used) and then place a large barrel or other container on a counter or other area which will keep your water supply higher than the toilet tank. A surgical hose or plastic pipe is then used to connect the water supply of the barrel to a spigot or sink (be sure the valve is open). When water is used at a level lower than the barrel, the water leaving the pipes will create a vacuum which will siphon water from your source into the pipes. While the water pressure will be low (making it take a while to refill the toilet tank), this system will work if the plumbing in the house is still intact following a disaster. The only drawback to this system is that US toilets use up to 5 gallons of water per flush (as opposed to 1 gallon for those of other countries). Therefore, unless you have a good source of water during a crisis, hauling water to keep your plumbing going is an iffy proposition. (The trick of placing a brick or two in the toilet tank will cut down on water use somewhat but also makes the toilet less efficient in cleaning itself.)

A cesspool or septic tank is normally needed to deal with human wastes. Such a system could be created so that wastes from your shelter or home (either through a gravity system or with a pump) could be sent to it and processed. This would be another great step up from both convenience as well as health standpoints.

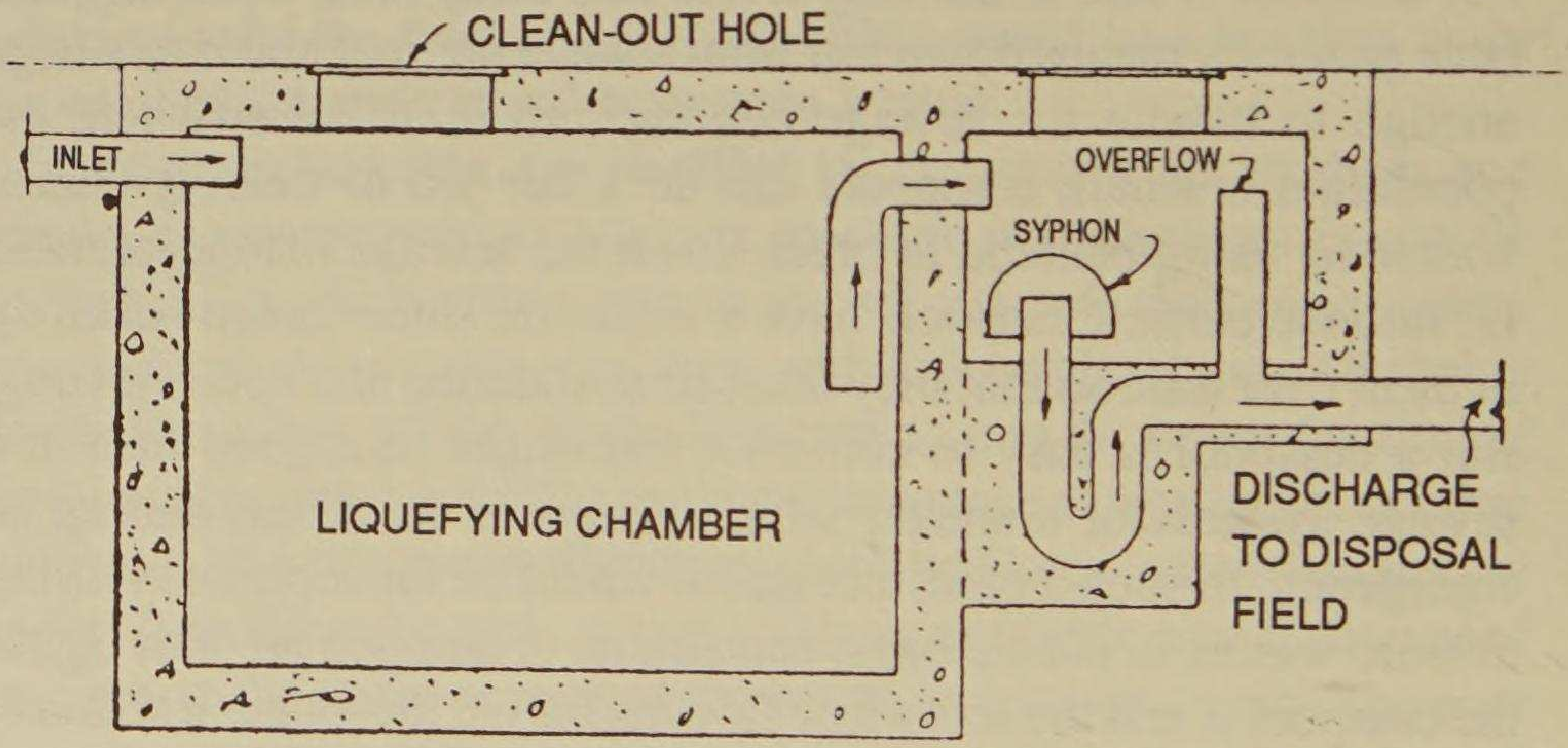
The cesspool was the forerunner to the modern septic tank. A cesspool is basically just a deep hole dug ten or fifteen feet into the earth and lined with bricks. The bottom is left open to the earth and covered with a foot or more of layers of sand, gravel, and rock (in that order). The top of the hole is covered air-tight to allow anaerobic bacteria to "digest" waste and to keep surface water out (as well as stray children and animals). Sewage is drained into this pit via a sewer pipe.

A cesspool is safe to use only if it is well away from water supplies (this generally means down hill from a water source) and if it is large enough to handle the sewage coming into it. In areas where the population is small, cesspools can do a fair job of treating human wastes by using bacteria to break down the sewage before it travels far into the earth. Cesspools have a finite life since sludge builds up in them over time so that they must be abandoned and new ones dug. But a cesspool is easy to construct and might be a good idea in a sewage system for a shelter which would be used only during an emergency. In such a case, a cesspool would be far superior to trying to store wastes in plastic bags, containers, or an open pit. The bigger the cesspool is and the less waste flowing into it, the longer it will last. Size should be at least 30 to 60 cubic feet per person using it.

The septic tank is similar to the cesspool but is made so that the sludge can be cleaned out of it and so that water from it is ejected back into the environment more fully processed and made safe (though it


GRADE
DEPTH DETERMINED IN FIELD

The cesspool was the forerunner to the modern septic tank. A cesspool is basically just a deep hole dug ten or fifteen feet into the earth and lined with bricks or rocks.


CLEAN-OUT HOLE
INLET
OVERFLOW
SYPHON
LIQUEFYING CHAMBER
DISCHARGE
TO DISPOSAL
FIELD

Simple septic tank. Note large clean-out holes.

is still wise to have the septic tank downhill from water supplies).

Modern septic tanks have one to three chambers; two chamber tanks are the most efficient and desirable. The first chamber collects all the waste and uses anaerobic bacteria digestion of the sludge. The second section holds the processed effluent until its chamber is full, then the liquid is automatically pushed out as more waste enters the system. While in the second section of some tanks, aerobic digestion takes place (these tanks have a vent pipe in the section chamber). The discharge from the second section of the tank is then routed through a pipe into "vitrification beds" of gravel; the vitrification beds expose the water to the air and sunlight (both of which kill many harmful bacteria) and then allow the water to filter into the earth or nearby body of water where bacteria finish breaking down any organic wastes in the discharge.

A properly balanced septic tank can, in theory, keep going forever. In practice, sludge will often build up so that it has to be cleaned out from time to time. Since no one will be making house calls to pump out septic tanks,you must be prepared to do the "dirty work" yourself. Therefore, it's wise to instal or build the septic tank with an extra large clean-out opening over each chamber in the top of the septic tank. These will allow the tank to be cleaned manually. (Do be sure to keep these openings secured so that the children can't open the tank up and fall in.)

Because of the work involved in cleaning out a septic tank by hand in a post-disaster situation, many might find a cesspool a better alternative to the septic tank. Digging a new cesspool would be easier than cleaning out the septic tank with small openings in its top! If, however, you live in the country or wish to have your own waste disposal system so that you'll be dependent on one less public utility, a septic tank is generally a safer, cleaner system to have.

Septic tank size depends on the number of people using it. To increase capacity, only the length and width should be altered since the depth is critical for bacterio-action. Ideally the depth of liquid in the tanks should be four feet with a foot of air space over it. Capacity for septic tank should be at least 10 to 15 cubic feet per person using the system. Septic tanks are generally constructed of concrete.

A septic tank should empty water into a vitrification bed. Many modern vitrification beds are buried in the ground; while bacteria in the earth are capable of breaking down the organic matter in discharge water, there is also some danger of contaminating ground water with this method.

To be on the safe side with an underground discharge vitrification field, the following test should be conducted: first dig down two feet into the area where the underground vitrification field will be placed. Next, pour water into the hole to a depth of six inches and time it as it seeps into the earth. Now divide the time by six (to determine the average time it takes one inch of water to sink into the earth) and use this rate of change to find the square feet of area to be covered by the vitrification field:

VITRIFICATION FIELD SIZE

TIME FOR 1-INCH FALL:	2	3	4	5	10	15	30	60
SQUARE FOOT SIZE NEEDED:	50	60	70	80	100	130	180	240

These figures are for ONE person using the septic system. The results you get should be multiplied by the total number of people in your group. If a large number of people are using a septic tank, then a number of vitrification fields is called for. These can then be connected together with "T" fittings in the sewer line.

A vitrification bed is usually a trench into which the discharge water travels through an iron or tile pipe. The pipe opens into the vitrification field composed of coarse gravel 8 to 24 inches deep. If the field is to be covered, a layer of plastic sheeting should go over the gravel and at least one foot of compacted earth over that. Vitrification beds which aren't covered by earth will have a greater efficiency since some water can evaporate into the air. The air will also speed up the killing of any dangerous bacteria which manage to travel through the septic system into the vitrification field.

It is wise to have sewer lines leading to and from septic tanks or cesspools placed well away from trees so that the system won't get clogged up with roots. If you don't have much running water or are limited in sewer pipe, it's also possible to build a "privy" directly over your septic tank.

Many self-sufficiency experts suggest using "compost" from septic tanks or privy's for fertilizer. This is generally a poor idea during the aftermath of a nuclear war since such sludge would be loaded with poisons (lead, mercury, Strontium 90, etc., etc.) as well as bacteria spores which had been eliminated from the human body. Placing such material on food crops reintroduces the poisons the human body has worked to eliminate. It's much wiser to avoid using this material in gardens or fields producing food crops. (Sludge might be used as fertilizer for crops like cotton or wind breaks, etc., where contaminants couldn't get into the food chain.)

Both septic tanks and cesspools use living bacteria to break down the household wastes entering them. The less air getting into the system, the better the bacterio-action in a cesspool (and in the first tank in a septic tank). Also, many household chemicals can kill off the bacteria necessary for efficient handling of organic waste in a cesspool or septic tank. Flushing such chemicals into a cesspool or septic tank can cause the system to fail and render a tank useless; great care must be taken in what is sent into the sewage system when it is a small, single unit. If the bacteria colony in a septic system is accidentally killed off, it is possible to purchase packages of bacteria spores of the type which "digest" wastes in septic tanks. These packages could save the day if you accidentally killed off the bacteria in a septic tank or if you were starting up a tank in a post disaster situation. These packets are available in many grocery or hardware stores.

If your area has large numbers of refugees and is uncontaminated by fallout or other dangerous materials, it's essential to get system of latrines set up and make their use mandatory. Failure to do this will guarantee the deaths of many of the survivors through disease and can quickly make large areas unlivable as well. Principle considerations in setting up latrines are to keep vermin (especially insects) out of the latrine and away from living areas and too keep the effluent coming from the latrine from seeping into the ground water or other water supplies. If at all possible, a septic tank system should be created for each latrine, though a cesspool directly under a latrine is a viable solution if speed is needed in setting up the system and all you have is hand labor and no cement. (See the US ARMY SPECIAL FORCES MEDICAL HANDBOOK ST 31-91B available from Paladin Press for $19.95 for an excellent how-to on making latrines and dealing with waste disposal in primitive situations.)

In a nuclear war, disposal of animal carcasses as well as human bodies would also be a prime consideration in order to prevent the spread of disease. Mass graves are usually most ideal if earth-moving equipment is available. If such equipment isn't available, bodies should be covered with dirt as close to where they are located as possible. Burning bodies is a viable alternative IF fuel and manpower are available for transferring bodies to a central location. Improvisation will probably be the name of the game in such a situation; wooden buildings might be utilized as large pyres.

You should give serious thought to waste disposal and toilet facilities; both would be of prime importance to your health and survival.

TUNNELING

Following a nuclear blast in heavily built-up areas, it might be necessary to tunnel through debris either to free yourself or to rescue others. In such a case, knowing how to tunnel would be a prime asset. Too, debris tunneling techniques might be used to "mine" cities of useful materials or used to create shelters by tunneling into the earth. Before starting any type of tunneling, it is good to remember that mining of any sort can be quite dangerous. Tunneling should be done only if it is actually necessary and will achieve goals not otherwise possible.

Before you start tunneling, be sure you know exactly where the tunnel should be headed. That done, start at the lowest point closest to where the designation area is. Doing these things will save a lot of hard work once the tunnel is started. If injured people will be moved through the tunnel, be sure to make it large enough to easily accommodate them. In areas where gas lines or water pipes might be encountered, some extra thought needs to be given to avoid having them block the tunnel once it is underway.

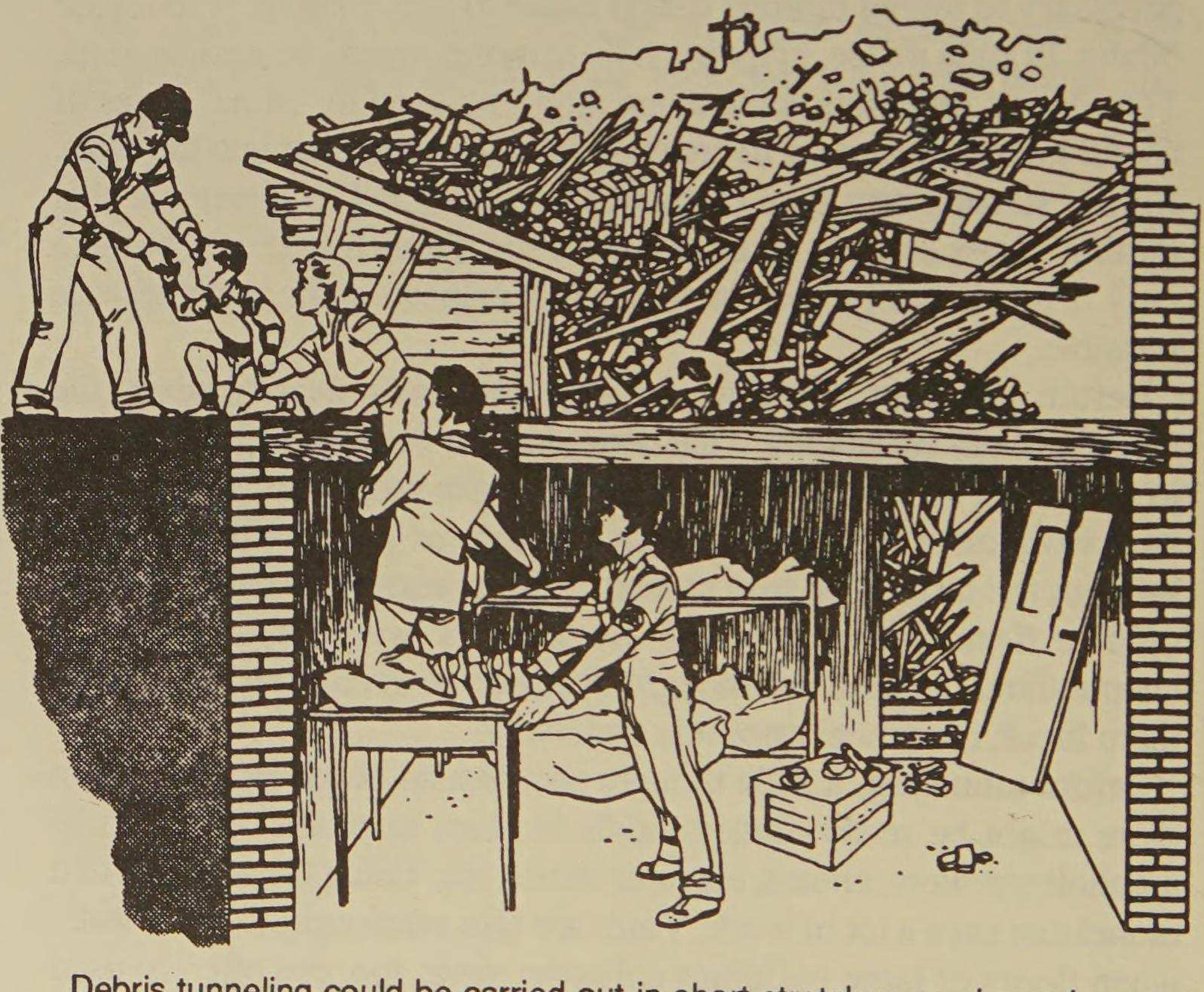
Before tunneling, a little thought should also be given as to where there might be ready-made tunnels in place in rubble. This can be manholes/sewers, chutes, elevator shafts, etc. Using these as part of a tunnel can save a lot of work. Voids are also often created along walls when floors of large buildings collapse; these, too, can often be used as part of a tunnel.

Crowbars, hammers, shovels, picks, and saws will all be needed if you're doing any serious tunneling. Dust masks, heavy gloves and boots, and hard hats are also near necessities.

A tunnel normally moves horizontally; a shaft is a tunnel-like hole which moves either vertically or diagonally. Construction of both is basically the same.

Timber is the material of choice in making a tunnel. Care should be taken to be sure it is large enough for the tunnel being made. If errors are made in dimensional sizes, it is best to err in having timber that's too big rather than too small.

Once the tunnel is constructed, great care must be taken by those traveling through it not to dislodge timbers, beams, or girders. Failure to obey this rule will result in disastrous cave ins. If at all possible, care should be taken to brace all tunnel members so that the pieces



Debris tunneling could be carried out in short stretches as shown here to rescue those trapped by rubble following a nuclear blast.

can't easily be dislodged by accident.

There are many methods of constructing a tunnel. Perhaps the best and quickest is frame and forepoling. Frames are the supporting elements in this technique and the forepoling is planks extended out from the frames. For best results, the frames should be built above ground and carried into the tunnel and positioned into place.

In this method of tunneling, framing can be rectangular or triangular. While triangular framing requires a slightly larger hole for workers to move through, it has the advantage of being considerably stronger and is less apt to collapse if uneven pressures are applied to it.

To extend the tunnel forward, a small amount of debris (or dirt) is removed and the first two frames positioned. That done, the forepoling planks are driven between the collar and the crownbar of one frame so that the planks extend beyond the second frame into the debris. A third frame is then assembled.

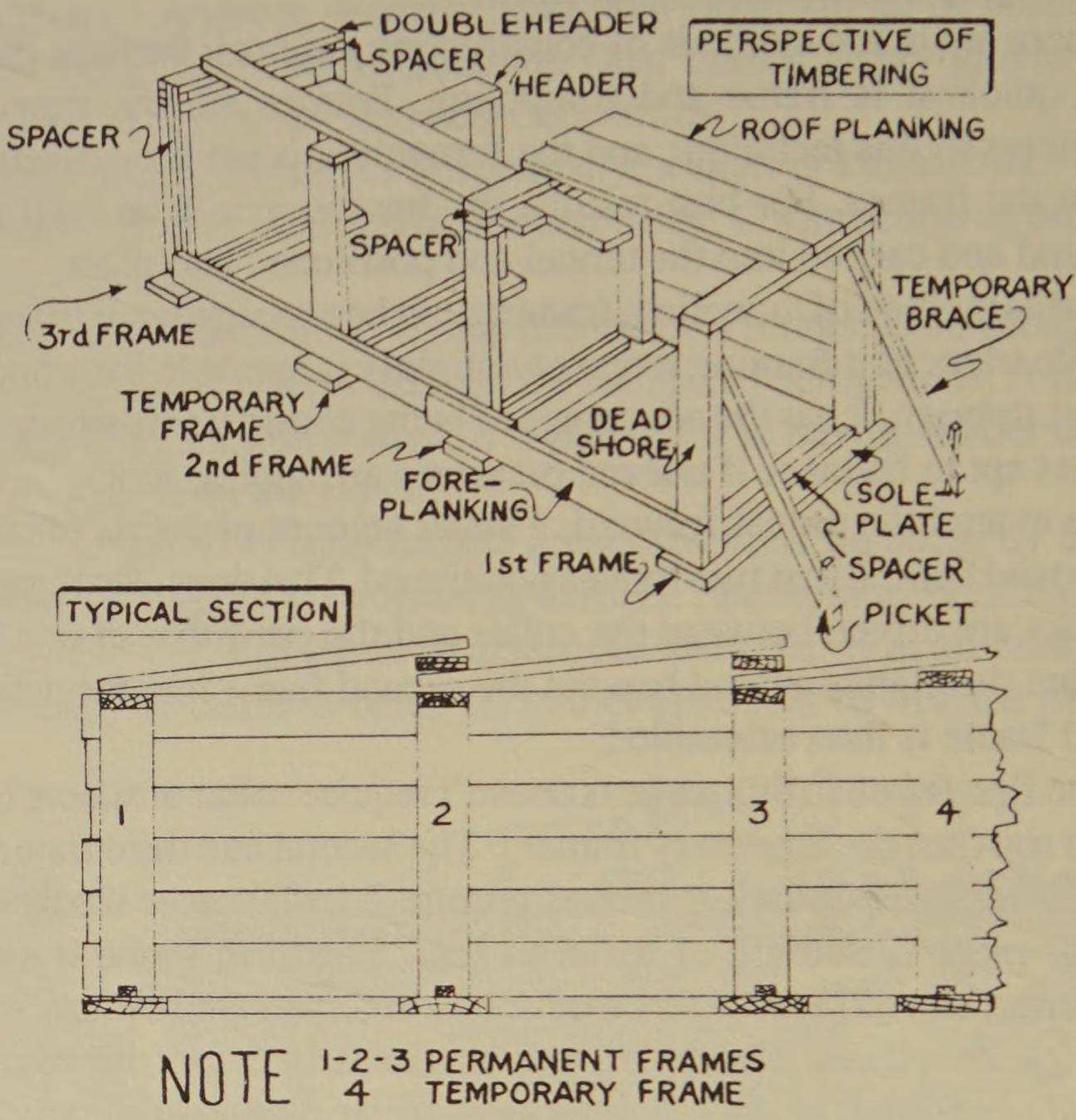
The first frame in this process doesn't require collar or spacer blocks at its top (nor do temporary frames). The second and third frames and all successive permanent frames require 2-inch spacer blocks and a collar piece set on top of the crownbar. The third frame is set first against a cleared vertical face of debris and then the first and second frames are placed next to it at approximately 3-foot intervals and solidly braced. The first frame needs to be diagonally braced with stakes driven into the ground about 2 to 3 feet in front of each strut.

After the frames are in place, the top of the frames (from the first to the third) are covered with long pieces of lumber to keep debris from falling into the tunnel over time. Next, the sides of the tunnel are lined by driving a board between the frame struts and the rubble.

When debris gets heavy, it may be necessary to construct a temporary frame to support the forepoles while material is being removed from the face of the tunnel for the next permanent frame. The temporary frame is removed after the permanent frame is positioned, braced, and lined.

At this point, the basic process of removing debris and adding frames is repeated time and again slowly extending the tunnel toward the point that the tunnel is to run to.

Tunnels through small, loose debris (or loose soil) should be boarded


DOUBLEHEADER
SPACER
HEADER
PERSPECTIVE OF TIMBERING
ROOF PLANKING
SPACER
SPACER
3rd FRAME
TEMPORARY BRACE
TEMPORARY FRAME
2nd FRAME
DEAD SHORE
FORE-PLANKING
SOLE-PLATE
SPACER
1st FRAME
PICKET
TYPICAL SECTION
1
2
3
4
NOTE 1-2-3 PERMANENT FRAMES
4 TEMPORARY FRAME

Tunnel construction using the frame and forepoling method.

as closely as possible to prevent material from falling into the tunnel and to keep the debris from shifting.

Great care must be taken in areas where dangerous gases might have been present during the collapse of buildings. Toxic gases or fumes from many types of liquids can remain trapped in pockets of building materials for extended times. Digging a tunnel into such a pocket could be very hazardous to workers. If you must tunnel in areas where such possibilities exist, then workers should tie a cord around their ankles when they enter the tunnel; a tug signal should be established so that those above ground can be sure the worker is OK. (Should the worker pass out or part of the tunnel collapse, the cord will also be a great aid in locating him.)

Many non-poisonous gases also become dangerous to tunnelers because they displace oxygen. In such a case, the worker can't breath in enough oxygen to remain conscious. Because of this effect, gas masks are often of little help when tunneling and may give those using them a false sense of security.

If debris is not too deep, then open-topped trenches can be used. Trenching is quite dangerous since a worker who is pinned at chest level or higher can suffocate if the debris collapses around him because it will keep his chest from expanding to inhale. Consequently, even if a worker has his head above the top of the trench, he isn't necessarily in a safe position.

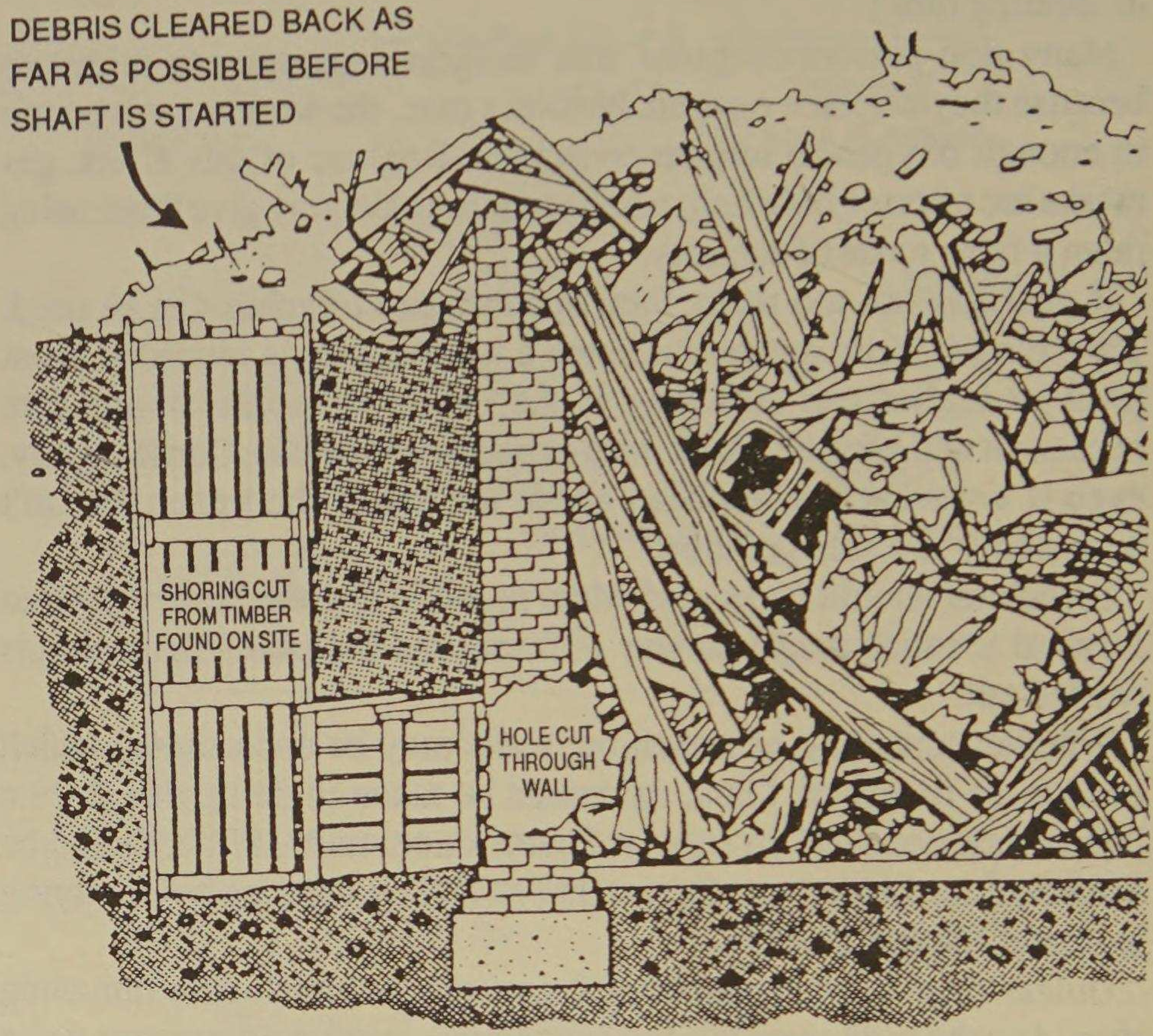
Trenching should be braced when possible and the bracing moved forward in much the same way as frame and forepoling tunneling is carried out.

Whether tunneling or trenching, walls may be encountered which need to be breeched. Great care must be taken in doing this since a bomb blast can weaken support beams or columns. Walls should be inspected for hidden cracks or other structural damage before trying to tunnel through them.

Unless there is heavy structural damage (in which case tunneling should not be tried since it is too dangerous), reinforced concrete walls or floors are nearly impossible to cut through without special power tools. This will generally dictate that the tunnel must detour to a hole already present in the concrete wall.

Brick walls can usually be tunneled through without having the masonry above them fall. Arch-shaped openings are generally the most secure holes to make through a brick wall. Other walls can often be tunneled through by creating a small hole through it and then gradually enlarging it by removing more material until it is large enough to travel through.

Tunneling is very dangerous. But after a nuclear attack, tunneling might give you the ability to rescue trapped survivors or escape from an area that has been heavily damaged.


DEBRIS CLEARED BACK AS FAR AS POSSIBLE BEFORE SHAFT IS STARTED
SHORING CUT FROM TIMBER FOUND ON SITE
HOLE CUT THROUGH WALL

Shafts traveling downward can also be created by using debris tunneling techniques. Arched holes can usually be safely cut through brick walls, as shown here, using only hand tools.

STOCKING UP

Obviously, you're going to have to have quite a few things stocked and stored to survive a nuclear war and its aftermath. The idea of living off the land or raiding your corner store is a nice cop-out for science fiction writers but not much of a survival strategy. To really have a good chance of surviving a long-term disaster, you'll need to have a lot of odds and ends saved away.

In preparing to survive a nuclear war, you will also nearly be able to survive a number of other natural or man-made calamities. A little extra work could enable you to survive all sorts of disasters. If you are interested in spreading out your chances of coping with various problems, then you should look into some of the "survival" books listed in the appendix of this book.

Most of the things you need to buy for use during and after a nuclear war are now as close to you as your nearest grocery, hardware, and clothing stores. And nearly all of the more "exotic" equipment you might need is easily ordered through the mail (except, perhaps, for firearms).

A number of lists of items you might need during a nuclear war have been compiled. These are good as a starting point, but you should sit down and give some serious thought to YOUR individual family's needs. Probably the best thing to do is to make a list of everything you use over several days' time. Study the list and make a second list of things you've used which will wear out in a year or two or might break and would REALLY be missed if you had to do without them. These are the things you need to stock up on, learn how to make yourself, figure ways to do without, or be able to substitute other things for.

There are many things that we take for granted and which are quite inexpensive now but which would be almost impossible to manufacture in most post-nuclear war communities: needles and thread, matches, toilet tissue, paper towels, Kleenex, sanitary napkins/tampons, pre-moistened towelettes, .22 ammunition, brushes and combs, medicines, etc.

Don't forget to stock any medicine or medical supplies which family members may occasionally need and try to purchase spare prescription eye glasses if anyone in your family has a strong correction.

If you're like everyone else, you'll not have unlimited funds to make your purchases. Budgeting gets tricky and can put a lot of strain on a family (and I've even talked to people who finally got a divorce because one or the other of the couple thought preparing to survive a nuclear war wasn't worthwhile). Therefore, it's wise to have a "council of war" BEFORE you get a lot of money tied up in gear and supplies. Too, try to purchase supplies that can be used whether or not a war occurs.

If possible, it's better to spend a little money over a long period time rather than a lot of money over a short period. Such budgeting can be as complex as you want or just a matter of buying a few extra cans of food (or whatever you need for your shelter storage) when you shop. Always buy something you can use if a nuclear war never takes place and rotate perishable items so that your money is never wasted.

You and your family should try to turn "survivalism" into a hobby or pastime. Don't dwell on the negative effects and death involved in a war; emphasize the possibility of surviving the war. Camping, hunting, target shooting (or just plinking), exercise, reading, etc., can all be directed toward developing talents that will help you survive a nuclear war without giving your children nightmares or making your spouse feel like they're married to Vincent Price or Vampirella.

Entertainment, while you're in your shelter avoiding fallout or after you're able to return outside the shelter, is an important consideration. Pencils, pens, paper, games, and the like are important for this. Don't forget to include a Bible (there are no atheists in fallout shelters—to paraphrase a bit) and some books.

Even if your family doesn't do much reading now, they will probably be interested in picking it up if there's a nuclear war going on. Reading will take on a new urgency when the information may make the difference between life and death later on. (Books can also be useful—when stored along the walls—for increasing the density shielding of your shelter.)

However, books take up a lot of room. If you have a limited space, perhaps the best way to pack books (including excellent reference books) into your survival stocks is to purchase a minifiche reader and books on minifiche. While a good reader for viewing the "microbooks" may seem like a large initial investment, the "books" are actually less expensive in minifiche and don't deteriorate over time (which is not the case with modern books whose paper starts crumbling in 40 or 50 years because of the acid in the paper). The money you save in the cost of "books" will more than pay for the cost of the reader and you'll also end up with a library of reference and entertainment books which you can literally store in a shoe box.

Unfortunately, there aren't any large companies offering microfiches of books suitable for a survival library (for a time, Micro Information Concepts, formerly Pocket Survival, was, but this company has since gone out of business). A few excellent microfiches are offered by Paul Doerr (for a catalog, write to Paul Doerr, P. O. Box 1064, Suisun, CA 94585).

An important step toward cutting down on the expense of preparing to survive a disaster is to learn to make things for yourself and how to repair what you have. Several books are available which will also aid you in "making do" and with making various supplies and items you need to survive on your own in a post-nuclear war culture. One group of books which have many secrets and how-to articles in them are Kurt Saxon's SURVIVOR Vols. I, II, III, IV, V, and (a soon to be released) VI; a set of these can give you a wealth of information. Most of the information comes from the 1800's or beginning of the 20th Century so that most of the tools and techniques are "low tech" and don't need power tools or a lot of electronic theory to carry out. The

SURVIVOR is available for $15 per volume from Atlan Formularies.

Another excellent book is HENLEY'S FORMULAS FOR HOME AND WORKSHOP which gives the details for all sorts of "how to's" with everything from making cheese to soap to insecticides. It's available from Loompanics for $14.95. The ESSENTIAL WHOLE EARTH CATALOG ($15 from Loompanics) and HOW TO FIX DAMN NEAR ANYTHING ($10.95 from Loompanics) are also excellent. The first tells you where to find a lot of essentials before an emergency and the second book, how to keep what you have going after the repairman quits making house calls.

Since doctors and functioning hospitals won't be too plentiful following a nuclear war, keeping your medical and dental work up to date is a good idea. Don't put off getting a tooth filled or put off having elective surgery done. Putting things off might mean you'll have a lot of pain and maybe even have to face a slow and painful death. Be sure, too, that family members are "up to date" on all recommended immunizations. (You can also learn to handle many medical problems yourself. Red cross and university first-aid classes are a good place to begin; encourage other members of your family to take the courses—you may need medical help sometime, too.)

Since you may have to deal with your own medical emergencies, you'll need some medical how-to books as well. You have to walk a tight line with these. If you tackle something you can't do, you may do more harm than good; at the same time, you may need to do more than basic first aid.

The "rule of thumb" is to do nothing if you're not sure doing something will help. The human body is able to heal itself from very grave injuries IF it's allowed to do so. Trying your hand at prescribing medication or do-it-yourself surgery may kill someone who might otherwise have survived. Far better is to offer support and care to someone so that their body can heal itself. Think before you do anything and leave things alone if you don't know what to do.

(Two life-threatening conditions which MUST be corrected are stoppage of breathing and uncontrolled bleeding. These must be corrected or death will result quickly. So in these cases, doing something is better than nothing. Otherwise, don't hinder the body's ability to heal itself. Basic first aid classes will teach you the procedures for these two operations better than any book can. GET SOME TRAINING. It will greatly improve your chances of saving someone in a medical emergency.)

Some books that will help you deal with medical problems both great and small are the US ARMY SPECIAL FORCES MEDICAL HANDBOOK (available from Paladin Press), THE MERCK MANUAL (Loompanics), TRIAGE EMERGENCY CARE BOOK (by Dr. Max Klinghoffer from Technomic Publishing Company) and SHIP'S MEDICINE CHEST AND FIRST AID AT SEA (from the US Government Printing Office). There is a wealth of other books you may want to add later, but these will give you a good start toward taking care of a lot of medical problems when there are no doctors around. Several excellent first-aid/medical self-help books which are designed for use for third-world countries are also excellent guides suitable for post-nuclear war use. WHEN THERE IS NO DOCTOR ($9 from Loompanics) and WHERE THERE IS NO DENTIST ($4.50 from Loompanics) are both excellent manuals that show how to care for all types of illnesses and problems AND cover improvised medications as well.

And what about medicine? There are a lot of over-the-counter drugs that would be of real help in improving things. Aspirin, fungicides, alcohol, etc., etc., would all be nearly invaluable.

You might also be able to get some of the more important antibiotics and other medications you might need by explaining to your doctor what you were preparing for and asking him to prescribe them to you with the understanding that they wouldn't be used EXCEPT following a nuclear war. When the expiration date passes for the medicines, you then take the unopened bottles to the doctor and he'd probably issue new prescriptions so that you can replace the medications. That's IF you have a doctor willing to do that and who will trust you when you say you're not a crazed drug addict. And medicine can be expensive.

Animal antibiotics and drugs are often identical to human medications but are available over-the-counter in pet stores. They offer a way for you to get some medications without the need of a prescription. With most of these medications, the animal medical counterpart can be substituted for human use on a pound-for-pound of body weight IF you know what you're doing.

In addition to pet stores, you can also purchase many animal medications through the mail. One good mail-order company is the Omaha Vaccine Co.

One small but very useful book which tells how to go about adapting veterinarian medicines to human use, is SURVIVALIST'S MEDICINE CHEST available from Paladin Press for $5.95. This book also gives some ideas on treating tetanus, typhoid, or gun-wound infections.

(When taking either animal or prescription antibiotics, take the whole series unless serious side-effects develop. Failure to do so may make the microorganisms you're trying to kill immune to the disease. Too, many antibiotics can be dangerous if used improperly and may also create harmful side effects; know what you're doing or leave things alone. And do NOT try to do your own doctoring if a doctor is available.)

Along these same lines of being able to do things for yourself is purchasing any tools you might need later on. A good array of tools will enable you to create equipment or even make specialized tools.

Among the most important tools and kits to have are wood-working equipment including chisels, rasps, planes, saws, etc., (and bear in mind the fact that electricity will be non-existent or at a premium); hammers and mallets of various types; screwdrivers (get a wide range of types); files (these are useful for making other tools—get a lot of spares); whetstones; hacksaw and blades; knives; pliers; vises; wrenches (or various sizes and types); crowbar/wrecking tool; etc. Don't forget to get a lot of extra screws, nails, staples, etc., either since making such fasteners would be a very time-consuming proposition at best. Also store away various oils, grease, and lubricants which you may need to keep your equipment up and running.

(Metal tools as well as guns or other equipment which may be stored for long periods of time can be protected from rust with a liberal coating of Outers "Metal Seal" which is available in most gun stores in a spray can.)

If you know how to use a lathe or milling machine, such an ability could be invaluable for making equipment as well as giving you a skill that could be bartered for food or other needs. BUT give some thought as to how such equipment might be powered by using a foot treadle or other power sources.

Masking tape, duct tape (get a lot), wire, nylon rope, and various types of glues can give you the ability to repair or patch up equipment. Consider getting a propane torch, solder, flux, and a lot of spare tubes of fuel toward this end, too.

For joining or repairing heavy canvas, leather, tarps, etc., an awl is nearly essential; these tools are also quite inexpensive. If you have trouble finding one, try a craft shop or order one from Brookstone for $7.95. Be sure to get spare needles and string for the awl as well (3 needles cost $4.50 and a large spool of 540 feet of thread costs $4.50 from Brookstone). And don't forget to have a a sewing kit with scissors, safety pins, straight pins, needles, and lots of strong thread. Clothing and canvas equipment will probably need to be repaired since it won't be easily replaced for most of us.

Several books which would be of great use following a nuclear war are THE MAKING OF TOOLS by Alexander G. Weygers ($10.25 from Loompanics) and THE MODERN BLACKSMITH ($8.25 from Loompanics). These cover a wide range of how-tool and toolmaking techniques. For those not familiar with hand tools or shop techniques, training manuals designed for use by high school shop and vocational classes would also be a good investment.

For many people, some of the more frightening tools of our modern age are firearms. As with other groups of tools, firearms deserve a lot of careful thought before you spend any money on them.

Since the government on the national, state, and even the local level may crumble during a nuclear war, it's probable that looters and criminals (or even invading soldiers) will be free to do as they please in many areas. Chances are good that you'll be the only one to protect your household.

Too, when people flee an area, one of the things they will carry with them is a firearm if they have one. In a recent US Government-sponsored survey, most people said they would take a firearm with them if they were ordered to evacuate their homes and EVEN if asked NOT to take any firearms. That means that anyone who has not prepared to survive a war and escapes from an area of destruction will probably have a firearm which they are willing to use to feed their family. You may have to fight off such people in order to survive.

Another group which you may have to defend yourself from are "freebooters." They have a very simple plan for surviving a nuclear war: find someone who has stocked up and raid them. These people spend their money on good combat weapons and gear and plan on taking what they need. Freebooters exist—I've talked to a number of them. (Also in this group will probably be renegade military and police personnel.)

All these groups of people would be very dangerous. There would be no reasoning with most of them. Even if you were able to give them the food they needed, many would not be satisfied unless they had everything you have.

Because freebooters are not going to take over your stores and then work on becoming self-sufficient and growing food, it isn't a simple matter of you sacrificing your life for theirs. If you don't keep freebooters from stealing from you, you will not only be sacrificing yourself and your loved ones but other good people as well since freebooters will just go on and kill others after they've used up your storage food and supplies. It would seem that you have a moral obligation to stop freebooters, looters, or any others that would cause people to perish to satisfy their own lack of foresight and morality.

Of course not everyone wandering around after a nuclear war will be dangerous. But many will and you'll probably be able to take few if any in since your resources will be limited. One way of discouraging such people from hanging around (as well as protecting your assets from petty crooks and varmints) will be to use fencing of various types to enclose gardens and living areas. Barbed wire or even razor tape wire may also be needed for real security. Currently, Phoenix Systems carries reels of barbed razor tape which can be quickly strung out if an area needs to be instantly "fenced" off. Each reel has 165 feet of wire and costs $20.

While a lot of the people wandering through your area in the aftermath of a nuclear war won't be dangerous, only one desperate man with a gun would be enough if you were unprepared to defend yourself.

At this stage of technology, there are no weapons which can quickly stop an armed man without gravely injuring or even killing him. (For a detailed look at how effective—and ineffective—weapons other than firearms can be, see Rexer's BRASS KNUCKLE BIBLE; though his red neck humor gets a little strident from time to time, the book gives a realistic assessment of how things now stand in hand-held weaponry. The book is available from Loompanics for $5.)

The bottom line is this: forget tear gas, stun guns, billy clubs, knives, etc., because they are all nearly worthless against a determined, armed foe attacking from any distance. To protect yourself from such people, you need a good firearm.

For combat, not just any gun will do. It must be in a caliber that is capable of quickly stopping an attack and must be capable of maintaining its accuracy whether you're firing 5 shots or 500. It must be easy to operate, clean, repair, and very reliable. It must be capable of making accurate shots out to 300 yards away (yes, combat takes place out to such distances).

The best caliber for combat is the .223 Remington (or 5.56mm NATO). Nearly all the Western military powers are adopting this cartridge for their battle rifles and the Soviets have come out with their own version of it. They all use it because it's effective over the normal combat ranges (300 yards or less with 150 yards being the normal outside range) and the cartridge is lightweight enough to allow a soldier to easily control his rifle and carry a lot of ammunition.

Military rifles for the .223 Remington are also lightweight. They are generally known as "assault rifles" because they are light and short compared to older military rifles which fire long-range rounds that—military researchers found—were much more powerful than needed for actual combat.

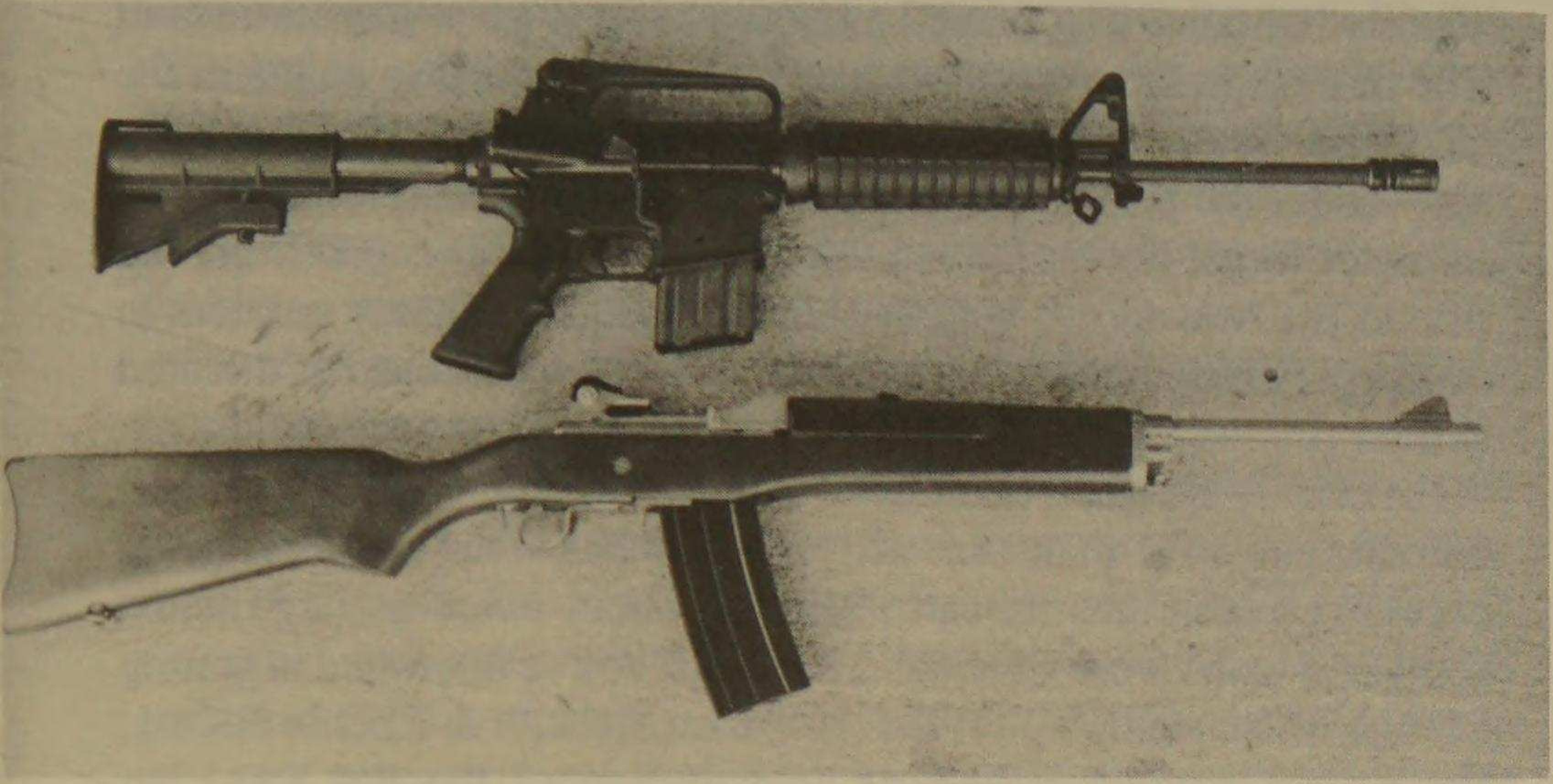
In the US, at the time of this writing, semiauto versions of many of the best military assault rifles are currently available for purchase by citizens and can be owned by anyone who is eligible to purchase any other type of rifle.

Semiauto fire (one shot per one pull of the trigger) is most ideal for survival use. Automatic fire is quite wasteful of ammunition; unless you have a military supply line behind you, you couldn't afford to use an automatic weapon to defend yourself. Too, there is a lot of red tape and money involved in purchasing an automatic weapon. And assault rifles—like all other semiauto firearms—can be fired rapidly enough to give a heavy volume of firepower if it is needed in close combat.

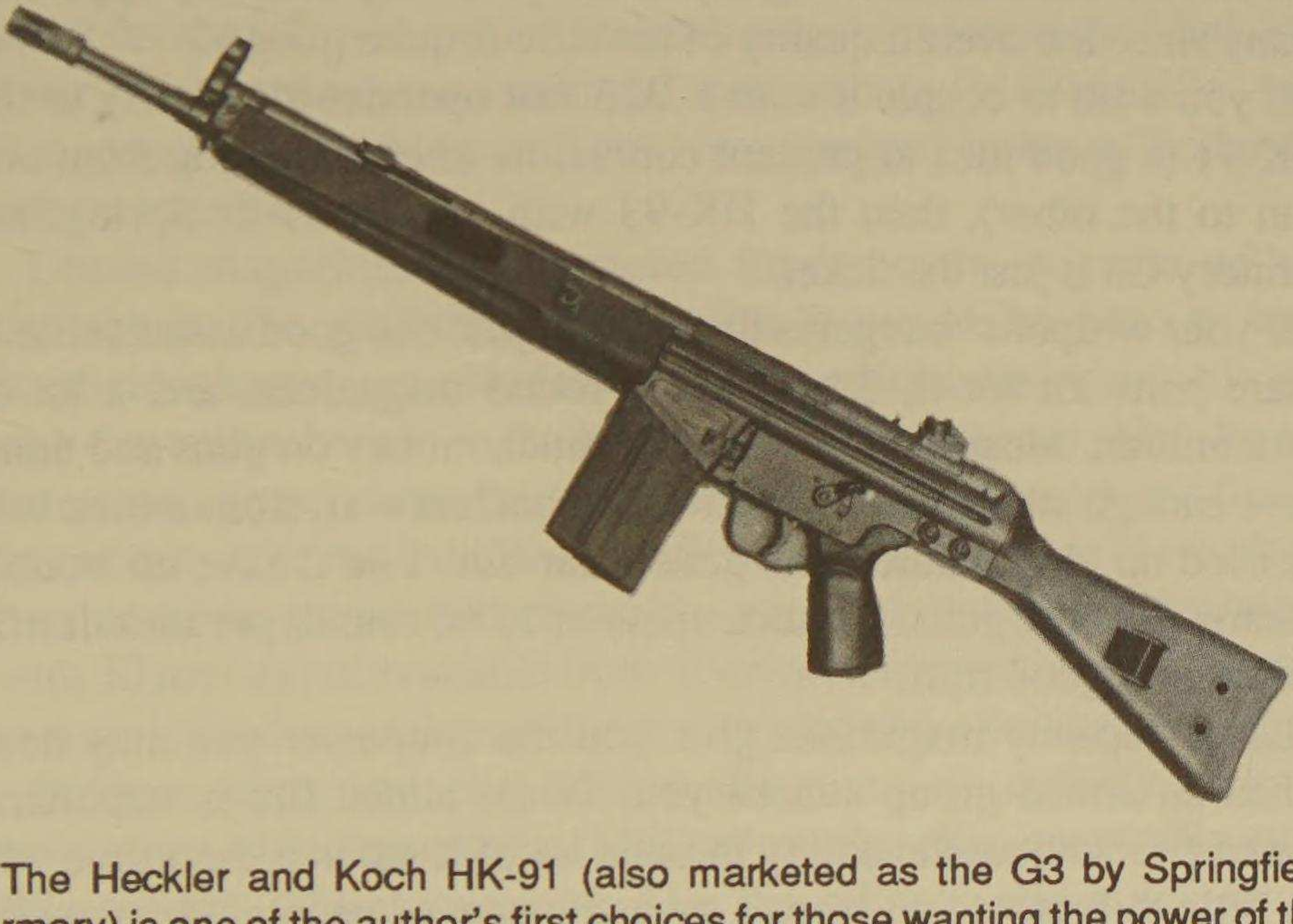
Currently, the best of the modern assault rifles is the AR-15. Although the AR-15 ("M16" is its military designation) gained a reputation as being unreliable in Vietnam, this was due to faulty ammunition and poor maintenance rather than any fault in the design of the rifle. Since these problems have been addressed, the rifle is now quite dependable; during recent trials by NATO, the AR-15 proved to be more reliable than the Galil (used by the Netherlands), the French FAMAS, British IW, and a number of other rifles.

A number of companies make good semiauto models of the AR-15, but the best are those originally made by Colt. Runner up to Colt is SGW. However, SGW offers some variations which Colt didn't make including 7.62x39mm and 9mm Luger conversion kits, fluted sniper barrels, stainless steel barrels, and the like so that SGW can sometimes help a purchaser get more of a "custom" gun than would otherwise be the case. (If you decide to purchase an AR-15 rifle, you'll probably be interested in my book THE AR-15/M16: A PRACTICAL GUIDE and/or my AR-15: SUPER SYSTEMS both available from Paladin Press. In these books I take a look at combat techniques needed for using such rifles, various trouble-shooting techniques involved in maintaining the rifles, various models of the rifles, and an overview of the accessories available for the AR-15s and how to modify the guns to suit your needs. The two books are currently available from Paladin Press for $16.95 each.)

Though not as tough as the AR-15, the Ruger Mini-14 is a good—and much less expensive—second choice. The rifle "looks" like a conventional hunting rifle but is actually a true assault rifle. Another consideration with the Mini-14 is the fact that a sister rifle, the Mini-30, is available which is nearly identical but chambered for 7.62x39mm cartridge (and possible several other hunting rounds in the near future). The Mini-14 and Mini-30 rifles would make an ideal



Two of the author's recommended rifles chambered for the .223 Remington cartridge. Top is the carbine version of the AR-15. Bottom rifle is the Ruger Mini-14 (shown here in its stainless steel version). Both are lightweight and reliable.



The Heckler and Koch HK-91 (also marketed as the G3 by Springfield Armory) is one of the author's first choices for those wanting the power of the .308 Winchester cartridge.

"family" of rifles if you need a hunting rifle to go with your assault rifle or wish to have a slightly more powerful round to augment the .223 rifle. Since both rifles function identically, you wouldn't be as apt—under the pressure of combat—to fumble around looking for a safety or forget how to reload the rifle when you changed from one rifle to the next (don't laugh—that's happened to many soldiers in combat). For a more detailed look at the Mini-14, the reader is directed to my MINI-14 BOOK available from Paladin Press for $10.

The .308 Winchester (also known as the 7.62mm NATO cartridge) is more powerful than necessary for combat. This means it gives excessive recoil and its cartridges are about twice as large when compared to the more efficient .223. But if you're interested in getting a tough rifle chambered for the .308, then Heckler & Koch's HK-91, Springfield Armory's SAR-48 (a variation of the FN FAL), or Springfield Armory's "G3" are first choices. All three rifles are tough and well made. (Springfield Armory purchases German-made parts and assembles them in the US as their "G3." This rifle is identical to the HK-91 but carries a slightly lower price tag and may appeal to many since the overall quality of the rifle is quite good.)

If you wish to couple it with a .223 that operates identically to the HK-91 (a good idea to prevent confusion when switching from one gun to the other), then the HK-93 with an HK-91 or Springfield Armory G3 is just the ticket.

If your weapons' budget is limited, get just one good assault rifle, a spare parts kit for it, 3 or 4 thirty-round magazines, and a lot of ammunition. Most people spend too much money on guns and don't have enough ammunition. Following a nuclear war, ammunition will be used up long before most guns wear out. You'd have no trouble trading for more guns. So stock up now; 1,000 rounds per assault rifle would be a good start.

Large capacity magazines give you the firepower you may need when an armed group attacks you. While aimed fire is important, aimed fire without the ability to put a lot of it out in a short time will do little to protect you from a savage group of people. Be sure you have at least 3 thirty-round magazines.

A spare parts kit will keep a rifle going for a long time. Even if you had two complete rifles, you could probably shoot longer with one rifle and a good spare parts kit because some parts break more frequently than others or are more easily lost. With the AR-15, be sure to purchase several firing pins, a number of cotter pins (which are easily lost), a couple of extractors, several extractor springs, and perhaps a spare hammer spring.

The critical part for the Mini-14 is the firing pin; these can't be easily purchased because they have to be fitted to the bolt assembly in order to remain safe. The best way of getting a spare firing pin is to remove the one in your rifle and send the rifle to Ruger asking for a replacement firing pin. Once you have two firing pins do NOT substitute either in another rifle without having the rifle checked by a competent gunsmith. While you're at it, order a spare hammer spring and a couple of spare extractors and their springs from Ruger to complete your spare parts kit.

A number of accessories are available for both rifles. Actually, you need very few and can get buy with the rifle, spare parts kit, and 30-round magazines. You might consider getting a Choate folding stock for the Mini-14 (which makes it possible to store the Mini-14 in a very small space) or a scope and scope mount for either rifle. After that, don't buy anything until you've got money to spare. Both rifles are great as they are.

Loaded magazines can be stored for 6 months or more without damage to the magazine spring. But it would be wise to leave magazines in storage unloaded or to rotate which ones you have loaded on a 6 month schedule so the springs don't take on a set. Also, be sure to test out all your magazines; many magazines don't work and finding out about it in the middle of a fight isn't too great. New plastic expanding magazines which can be stored indefinitely while charged with 30 rounds are available from Sherwood International if you wish to store loaded magazines without worrying about the springs in them.

Stripper clips and clip guides allow you to quickly recharge magazines with ammunition. Military surplus clips are readily available for the .223 ammunition. Use the military clip guide for the AR-15; with the Mini-14, purchase a Choate guide to feed the ammunition from the clips into the Ruger rifle's magazines.

You will need something to carry spare magazines in. Don't carry metal magazines in pockets; a bump on the magazine lips can damage them to the point that they won't function properly. The new plastic magazines can be carried in a pocket since they are very resistant to such damage.

A better way to carry magazines is in the magazine pouches designed for the US Military; 30-round AR-15 and Mini-14 magazines will both fit into these. These 3-magazine pouches are also readily available from the military surplus companies listed in the appendix for very reasonable prices. The pouches can be clipped onto almost any belt though you may prefer to buy a military nylon belt to put them on. (First aid kits, canteens, and other pouches are also available to fit onto these belts as well as suspenders to help keep all the gear up. Get the other stuff IF you need it; but don't get burdened down because you're trying to play soldier. Your goal is to defend yourself, not win the Battle of the Bulge. "Fight light" if you want to win gun battles.)

Michaels of Oregon sells some excellent light-weight nylon belts which will also work to hold magazine pouches. The company also has a wide range of knife, compass, flashlight, and gear pouches as well as pistol holsters, speed-loader pouches, and pistol and rifle magazine pouches. If you wish to carry other gear with you a "butt pack" for the belt is also made. These are all reasonably priced and available in black or camo pattern. Michaels of Oregon belts are my first choice for carrying magazine pouches coupled with the other odds-and-ends that most of us like to carry when hiking or guarding an area.

Get a military-surplus cleaning kit for your rifle along with plenty of spare cleaning patches and several spare brushes. This kit can also be used to clean .22 rifles or pistols and brushes are available to allow you to use short sections of the rods to clean pistols. Good cleaning/lubricating fluids to use for your rifle are Breakfree CLP and Tri-Lube; both can be used for cleaning firearms and lubricating them. Both are available in most gun stores and Breakfree can be purchased directly from Sierra Supply. Take care to not over lubricate any firearm as this will cause it to pick up dirt and will actually cause more wear and tear on it in the long run.

Your next firearm purchase should be a .22 rifle (these are covered in the chapter about food and dealing with pests). Though sometimes recommended for self defense, the .22 is not ideal for such use. It doesn't have a great enough range and it doesn't "down" an opponent quickly enough to keep him from killing you before he succumbs to his wounds.

But a .22 would be very useful for odd chores such as foraging, dealing with packs of dangerous animals, or killing pests. (And yes, it might even be used for self defense or harassing fire in a pinch—but almost any other caliber would hold an edge over it.)

You can hardly get too much .22 LR ammunition; 2 to 5 thousand rounds is a good start with several hundred CCI CB Caps being a bare minimum for the quiet shooting of pests. (Be sure to add traps and a fishing kit to your stock of tools and supplies. These can add a lot of meat to your table from time to time with a minimum waste of time and supplies.)

All types of ammunition must be stored in a cool, dry place. Self life for ammunition is 30 to 40 years and will be much longer if the ammunition isn't exposed to heat. (It's possible to make powder, recharge primers, and create your own bullets in order to keep using your firearms. It is also a whole lot of work. I've outlined the procedure for reloading ammunition including how to make powder and primers in COMBAT AMMUNITION available from Paladin Press for $19.95. While it's better to buy the ammunition you need NOW before a nuclear war, being able to reload ammunition following a nuclear war would give you a skill that might be very useful in bartering to get meat—as well as bread and vegetables—on the table.)

After you have an assault rifle and a .22 rifle, you may wish to consider a good self-defense pistol. While a pistol will never be capable of "matching" a rifle in combat, sometimes you'll need to be using both hands to work and may not be able to carry a rifle. In such a case, a pistol is ideal since it can be worn and brought into action in a moment's notice to buy you enough time to make a hasty retreat from danger. Too, a pistol can be concealed on your person if you need to do so.

Modern 9mm (Luger or Parabellum) ammunition topped with expanding bullets is probably the most ideal choice for self defense. Semiauto pistols available for this round can be purchased with large-capacity magazines and the pistol's self-loading action will absorb a lot of the recoil of the round so that you'll have better control of the weapon without any sacrifice of power.

Among the best choices for the 9mm are the Beretta 92 series of pistols; the FIE TZ-75 series of pistols; and the new Ruger P-85. These guns are super reliable, function with a wide range of ammunition, and are reasonably priced. Second choice in pistol calibers are revolvers with the .357 Magnum pistol being first choice for defensive use; of all the .357 wheel guns made, the Ruger GP-100 stands head and shoulders above the others and is first choice.

The .45 Auto has been touted by many in the past as THE weapon. This has changed with the new reliable bullet configurations used on .357 and 9mm ammunition. In fact, the .45 Auto performs on a par with much of the new .38 Special Plus-P ammunition making it (and the .38) a distant third as far as hand gun rounds are concerned. The Ruger SP-101 is first choice in the .38 Special guns (with the GP-100 capable of shooting the .38 Special round as well); Colt's .45 Auto is an excellent choice with Auto Ordnance and Springfield Armory's "no frills" versions of the gun being good but less expensive alternatives.

You'll only need several hundred rounds of ammunition for your defensive pistol since any encounters you make will be quickly over. Do get a couple of extra magazines with any of the semiauto pistols or some speed loaders for your revolver.

Michaels of Oregon ("Uncle Mike's") offers excellent nylon holsters (with and without flaps). In addition to being super-tough, Uncle Mike's gear has very low price tags and is available in most gun stores. The company also makes models of holsters for all the common pistols and revolvers (as well as excellent rifle slings, rifle carrying cases, and other products).

Shotguns? A 12-gauge, or even the 20-gauge, shotgun has no peer within 30 yards. But beyond 30 yards the pellets start to lose their effectiveness and accuracy is very marginal at best. Shotgun ammunition is large and current weapons are impossible to reload quickly. A shotgun just isn't capable of doing what is needed in most combat. Therefore, I feel you'd be better off not getting a shotgun unless you're prepared to have a weapon which can only be used in close, limited engagements and which is awkward to carry, load, and use. An assault rifle is a much better choice of weapon for post-nuclear conditions with a pistol being ideal when your hands are full.

If you must have a shotgun, pump shotgun actions are more reliable than most semiautos. Probably the best buy in pump guns is the Mossberg 500. The Remington 870 (18- or 20-inch barrel); Ithaca 37; and the Winchesters are all good pump actions which are also readily available. About the only two semiauto shotguns which are strong enough for survival use are the Franchi SAS-12 and PG-80 (imported into the US by F.I.E.); these are good but won't function with as wide a range of ammunition as the pump guns will. Whether pump or semiauto, you should get an extended magazine on your shotgun if it doesn't come with one since shotguns are very hard to reload under fire.

If you want a "just in case" single-shot shotgun, then F.I.E.'s Brazilian-made Hamilton and Hunter series is a good and inexpensive choice.

Shotguns waste a lot of lead and powder when used for hunting; traps and .22 rifles make more sense in a survival situation. Therefore you'll only need several hundred rounds of shotgun ammunition for combat. You'll not need more ammunition than that unless you're a very lucky person; that many "close encounters" would be extremely hazardous to your health.

After you have the first "round" of purchases of firearms (one assault rifle, 1 .22 rifle, and one pistol), consider adding other assault rifles to your "arsenal" IF you have members in your family who will be capable of using them. (And don't sell older youngsters and women short; both can do quite well with .223-caliber weapons—often better than men—and should not be hesitant to learn how to use such rifles. The increased firepower two or more people can put out would greatly enhance your chances for winning a fight.)

Add more pistols to your collection of firearms as you feel suitable but don't go overboard with them; try to be realistic and not purchase more guns than you need. Guns are expensive and can quickly eat up money that might be better spent on other equipment.

Whatever firearms you end up with, be sure that you and your spouse and older children know how to operate them. Practice will enable you to defend yourselves if the need should ever arise. And be sure that the guns stay out of your younger children's reach and that children understand how dangerous guns are.

Bullet-proof vests, helmets, etc., are probably not necessary and should only be purchased when other essential stocks have been secured. While modern ballistic vests stop most pistol rounds, unless you get a heavy vest with steel inserts, it won't stop most rifle bullets. And if you get a vest or helmet, don't get to thinking you're Superman. You may have a rude awakening.

Since fashion won't be too important following a nuclear war, you'll be able to get by with a lot of clothing that you might not be caught dead in during normal times. Nevertheless, clothing will become a problem years down the road. One way of delaying the problem is to purchase a lot of tough clothing, shoes, and underwear since these will be hardest to replace or make. Work gloves should also be high on your list of things to buy and don't forget to purchase some heavy coats for each member of the family (remembering that there could be a swing toward cooler temperatures—an important consideration if you live in the sun belt and have a minimum of cold weather to contend with now).

Ultraviolet light may be capable of giving you a sunburn in a matter of minutes following a nuclear war's damage to the ozone layer; be sure that each family member has a wide-brimmed hat, light gloves, and good sunglasses capable of stopping ultraviolet light.

Most of the utilities that we depend on to maintain our standard of living will be gone and the supply lines as well as the power plants that produce the supplies or energy will be damaged; it will be a long time before utilities become functional in many areas. Since billing for the use of utilities depends on having some sort of money that is accepted by all, unless the government starts running its own power companies (and again, how will they collect taxes if no one is using money?), you should be prepared to be without or create your own sources of water, heat, electricity, gas, and gasoline substitutes.

Having a house that can be at least partially heated by wood and being in an area where you can harvest and grow wood, would put you halfway home as far as your energy needs are concerned following a nuclear war. Though getting wood is a hassle, you could use it for heating your house and cooking much of your food.

If possible, you should improve the efficiency of your wood-burning fireplace or stove (or get one installed) now, while you can. And remember that the old-fashioned fireplace is not nearly as good as a wood stove for heating. Fireplaces send a large percentage of your heat up the chimney. If you're cutting wood by hand, this is an important consideration.

A fireplace "insert" will improve the efficiency of your fireplace. If you don't yet have a wood-heating system, keep efficiency in mind when you purchase one. Also, don't get a system which needs electricity to circulate the heat. One excellent book which covers all aspects of using a wood burning heating system (from where to get them to how to cut logs and clean chimneys) is Mary Twitchell's WOOD ENERGY (available from Loompanics for $7.95).

Could you generate your own electricity? Unfortunately, this isn't too easy or too practical—which is why most people simply connect themselves into the power grid furnished by public utilities in the first place.

There are a number of ways to generate electricity. Probably the easiest is to use solar panels coupled with storage batteries. Passive solar energy can also be very useful in heating a home or water. Unlike "active" systems which generate electricity or need electricity to run, a passive system converts the energy of the sun to heat (generally by exposing a black panel or water container to sunlight). Passive energy systems are practical in many parts of the country and generally need very little maintenance. Coupled with energy-efficient architectural designs, passive systems are very effective.

One good book about passive systems for houses is SOLAR DWELLING DESIGN CONCEPTS put out by the US Department of Housing and Urban Development and US Department of Energy (1976).

If you are interested in generating your own power—whether from solar energy or other sources, Loompanics carries several titles worth checking into. Among their more informative titles are INDEPENDENT POWER SYSTEM ($7), WIND POWER FOR THE HOMEOWNER ($18), HARNESSING THE WIND FOR HOME ENERGY ($7), AND HARNESSING WATER POWER FOR HOME ENERGY ($7). Loompanic's THE SOLAR ELECTRIC BOOK also gives excellent information on using solar cells which—in addition to being useful in a nuclear war situation—are ideal for many everyday uses as well (cost of the book is $11.95).

Wind energy can also be converted into electricity. It isn't as easy as one might think, however. You'll need to be in an area with a lot of wind that continues most of the time and a spot that is clear of obstructions which might divert the wind from your generator. Perhaps the greatest shortcoming from a survival standpoint is that a wind generator has to be on a high mast. This can act like a beacon in drawing people into an area during the best of times; during a crisis, this would make it hard to keep a low profile. Too, wind generators are prone to damage from blast waves.

If wind power is of interest to you, one helpful source of information is WIND MACHINES, a report prepared for the National Science Foundation by Frank R. Eldride and the Mitre Corporation in 1975.

Both solar cells and wind generators work best when coupled with a battery bank so that their energy can be used when needed rather than when available. Inverters enable the low DC voltages produced by such systems to be boosted to 110 volt AC power if you need it. Kootenai Radio & Energy is a good source for inverters (as well as other electrical equipment, EMP-proofing systems, and solar cells) which with you can convert 12-volt DC power (which is generally used for storing solar energy) into 110-volts AC. This would enable you to use standard power tools or run other equipment for short periods of time. (On the flip side of the coin, the company also sells cordless power tools that can be charged using the 12-volt output from the solar cell/storage cell system, wind generator, or any other car generator/battery/12-volt system.)

There are two ways to go with power inverters: efficiency or initial cost. High efficiency inverters mean you'll get more 110 volt AC power with less drain to your battery array. But high efficiency inverters cost more, making your initial purchase more expensive.

One very good inverter which has a 90 percent efficiency is the Heart Interface; cost is around $400 for a 300 watt unit (which can handle surge loads of up to 1,000 watts for up to a minute). At the low efficiency/low cost end of the scale are the TrippLite inverters with from 50 to 80 percent efficiency which cost a lot less but are more "expensive" to operate over the haul. Give this some careful thought and try to imagine how much power you'll be needing. (Most electrical equipment has its wattage listed on it somewhere. The only catch is that some types of motors need an extra surge of energy to get started. A "quick and dirty" way of changing amps to watts is to multiply the number of amps by 100. While amps are not the same as watts, this method may be of help for rough estimates).

Because an array of storage cells are essential to a solar cell or wind generating system, thought must be given to batteries. The best batteries for this use are those made for electric vehicles (like golf carts and forklifts). These last 7 to 10 years but cost a bundle and weigh a lot. The RV/marine 12-volt battery costs less but is designed for small systems and only lasts up to 5 years even with careful use.

One of the worst batteries for solar/wind electrical storage is the car battery. BUT it's probable that car batteries are the type of battery which will be readily available for the first few years following a nuclear war. Therefore, I feel that you should purchase electric vehicle batteries for any system you may be using presently and have the know-how to substitute car-type batteries following a nuclear war.

If you have access to a lot of wood or other fuel, it might even be possible to locate a steam generator (though these are a little hard to come by since the introduction of the internal combustion engine). Steam engines could also be coupled with belts to directly power other tools and carry out work now done by electric motors.

If you are able to work with internal combustion engines, then such engines probably make more sense from a do-it-yourself repair standpoint than any of the other power systems mentioned thus far. Car engines might even be adapted to use as giant generators to give you large-scale power in the kilowatt range (check page 472 in Volume III of Kurt Saxon's THE SURVIVOR to see one such plan that was used in the US during the '20's or '30's). No doubt on a more practical level, small generators like those available for camping or emergency use from Honda and a number of other companies might also be adapted to supplying small increments of emergency power.

The problem with gasoline generator systems is that it's dangerous to store gasoline and the fuel deteriorates with time—a year is the upper limit of storage. Gasoline can be treated with special chemicals which extend its storage life to several years (these chemicals are available from several mail-order stores including Survival Center). But, even assuming you have a large storage tank of fuel buried in your back yard, what will you do for fuel several years down the road?

One alternative is to use diesel fuel. Diesel fuel stores for a longer period of time and is less flammable. But there aren't many generators on the market which are built for diesel fuel and those few that are for sale are quite expensive and even more complicated to maintain and repair than gasoline generators. And you'll eventually run out of diesel fuel, too.

Both gasoline and diesel fuel are complicated to make. Before they can become available following a nuclear war, there will have to be a work force for creating and distributing the fuels as well as run a large distillery. Alcohol can be used to power modified gasoline engines. Unfortunately, it doesn't have the umph that gasoline has since it burns at a lower temperature. And it isn't as easy to make as one might be hope. Alcohol can be manufactured with a simple "moonshiner's still" made of junk copper tubing or even radiator parts but distilling the alcohol requires a lot of fuel and constant monitoring of the "brew" to be sure you're distilling alcohol rather than water. Spending a day distilling enough alcohol for a few hours of power might not be much of a trade off. And since you need sugary (or starchy) plant material to create the alcohol, you'll also have to sacrifice a lot of potential food as well as fuel and time to create any alcohol.

So alcohol for powering gasoline engines is not all rosy. But it could be done if you needed power badly enough. Two good books for finding out how to modify gasoline engines for use with alcohol as well as showing how to distill the alcohol a number of ways (including with solar stills) are BROWN'S ALCOHOL MOTOR FUEL COOKBOOK (available from Loompanics for $9.95) and ALCOHOL FUEL HANDBOOK (from The Mother Earth News for $12.95).

Whatever type of electrical generator you end up with, contact Kootenai Radio & Energy and purchase their electronic "switches" which are needed to protect your expensive power supplies from EMP damage; solar panels, wind generators, hydroelectrical generators, diesel generators, steam engine/electrical generators or whatever all need to be protected from EMP.

Lack of gasoline will have a very great effect on most travel and farming. You should plan on restricted travel, trade, and farming. Bicycles, horses, and alcohol-powered equipment will probably replace the gasoline-powered equipment.

Farming will be changed in other ways. There will be a need for more farmers to make up for the lack of fertilizers and insecticides as well as the absence of gasoline for machinery. One farmer won't feed as many people as he now does. This means you'll have to face higher prices (in barter goods, not money) for food and you'll need to be able to grow most of your own food for yourself or have a "big demand" skill that will enable you to barter it for the food you need.

In small communities, there could be a return to some semblance of law and order shortly after a nuclear war. But open roads and areas around cities will probably be something out of the old West with lone travelers or isolated farms in constant danger.

Will a national government be reestablished following a war? Certainly the lack of communication and the inability to travel would seem to preclude this. Added to a new US Government's problems would be a lot of hard feelings when people learn that Congress ringed Washington, DC, with complex shelters filled with freeze-dried food and electric cars (not to mention tennis courts and underground lakes) while voting down money for needed civil defense programs. Paying taxes to a government that did next to nothing to defend its citizens probably won't be a popular idea. And lack of a viable government means that there will be no money; again, barter would be the likely method of carrying on commerce.

When thinking about an economic system based on barter, there are a few things to keep in mind. Since a nuclear war will deplete the population, many things which would be ideal for barter now (like gold, silver, and jewelry) will actually survive the radiation and may be relatively plentiful compared to the number of people who survive. On the other hand, items which are easily produced in a "high-tech" culture will be scarce or unavailable.

In effect, the traditional idea of wealth and value will be turned on its head. Penicillin, bullets, even candy or razor blades will be of more value than bars of gold to many survivors. The real plus to this for anyone that is preparing to survive is that many of the "hi-tech" goods are plentiful and easily purchased NOW. Stocking up now could give you great wealth in such a barter economy. Just be sure that you purchase items that you can use if you can't trade them off or if there is never a nuclear war.

(For more details on barter techniques and setting up a barter economy, see my book, SURVIVAL BARTER, available from Loompanics for $7.)

Many areas which are hard hit by nuclear blast will require a lot of rebuilding. Raw materials in the form of junked autos, scrap lumber, and rubble will be readily available for those who know how to build. Loompanics SHELTERS, SHACKS AND SHANTIES is a book that would be very useful in such a situation. It shows 18th Century styles of building everything from sod houses to railroad tie shanties; cost is $11.95.

Trade may take place in rather lawless conditions. Too, local or state governments may spring up which are oppressive and interested in taxing anyone with "wealth." Therefore, keep a low profile, don't display all your wealth, and be prepared to protect yourself should you become the target of either thieves or of a corrupt "government." Along the same lines of thought, it might be a good idea to have hiding places where you can squirrel away supplies both now and later on.

You'll need to be flexible to survive the aftermath of a nuclear war. You'll need to be prepared. Now is the time to get to a safe area, construct your shelter, and lay in your supplies. Now is the time to develop the skills necessary to perform first-aid, grow plants, and defend yourself. A nuclear war may never come. But if it should, you must remember that times don't have to be easy in order to give you pleasure. Life was hard for our forefathers and the millions who have lived before us. The many conveniences we enjoy now aren't necessities. We would lead no less full lives without electricity or running water.

The things you own can't bring you happiness. Living each day to its fullest. Friendship, a loving family, a strong faith in God, enjoying just being alive; these are the truly important things that will last, can help you to survive the worst of times, and will give you true joy.

Start preparing to survive... It may be later than you think.

APPENDIX

SOURCES OF USEFUL EQUIPMENT AND PUBLICATIONS

Aegis international (Bi-Monthly Magazine)
Weinbergstrasse 102
P. O. Box
CH-8035 Zurich, Switzerland (European CD work and new CD equipment reviews)

Alnoroy Nuclear
2585 Washington Rd, Suite 120
Pittsburgh, PA 15241 (Distributor of Alnoroy radiation equipment)

American Civil Defense Association
Box 1057
Starke, FL 32091 (Plans for constructing earth-sheltered home capable of doubling as fallout shelter; JOURNAL OF CIVIL DEFENSE)

American Survival Guide (Monthly Magazine)
2145 W. La Palma
Anaheim, CA 92801 (714) 635-9040 (Survival articles and how-to information)

Atlan Formularies
P. O. Box 327
Harrison, AR 72601 (Sells all the Kurt Saxon books and also markets anumber of hard-to-get chemicals which might be of use to survivors of a nuclear war)

Beeman's
47 Paul Dr.
San Rafael, CA 94903 (Beeman/Webley Vulcan II air rifle; Webly air pistols)

Brigade Quartermasters, Ltd.
1025 Cobb International Blvd.
Kennesaw, GA 30144-4349 (Freeze-dried military-style food packets and military surplus type equipment)

Brookstone Company
127 Vose Farm Rd.
Peterborough, NH 03458 (Hand tools, saws, clamps, sharpeners, etc.)

Charley's Greenhouse Supply
12815 Northeast 124th St.
Kirkland, WA 98033 (Greenhouse supplies and books)

Choate Machine and Tool
P. O. Box 218
Bald Knob, AR 72010 (Accessories for Mini-14, AR-15, Mossberg 500, Remington 870, etc., firearms)

Cross Seed Company
RR #1
Bunker Hill, KS 67626 (Gardening seeds)

Daisy Manufacturing Company
Box 220
Rogers, AR 72757-0220 (Manufacturer of excellent air rifles and pistols)

Direct Safety Company
P. O. Box 8018
Phoenix, AZ 85066 (Retail sales of North, 3M, and other masks and filters as well as other accessories)

Directions (Monthly Newsletter)
Edited by Duncan Long
P. O. Box 1743
Harvey, IL 60426 (Survival information and how-to articles)

Dosimeter Corporation
Box 42377
Cincinnati, OH 45242 (Radiation meters, dosimeters, dosimeter chargers)

Dover Books
180 Varick St.
NY, NY 10014 (How-to and reference books)

Dynamit Nobel
105 Stonehurst Ct.
Northvale, NJ 07647 (RWS Model 45 air rifle)

Emergency Planning Journal
Emergency Planning Canada
Ottawa, Ontario, CANADA K1A 0W6 (Quarterly journal for Canadian civil defense)

Fighting Chance (Monthly Newsletter)
Oregon Institute of Science and Medicine
P. O. Box 1279
Cave Junction, OR 97523 (Newsletter with lots of survival information and how-to)

Industrial Safety and Security Company
1390 Neubrecht Rd.
Lima, OH 45801 (Retail sales of 3M and Wilson masks and filters as wellas other accessories.)

J. Flores Publications
P. O. Box 163001
Miami, FL 33116 (Military, firearms, survival books and video cassettes)

Kootenai Radio & Energy Systems
Box 215-DS
Kootenai, ID 83840 (Offers very competitively-priced radio and power-generating equipment including solar cells. Also carries EMP-proofing filters for electrical equipment.)

L. L. Baston Company
P. O. Box 1995
El Dorado, AR 71730 (Dealer in Colt AR-15 parts and accessories for the 10/22, AR-15, Mini-14, HK-91 and other firearms.)

Lab Safety Supply
P. O. Box 1368
Janesville, WI 53547-1368 (Tyvek suits, storage containers, emergency equipment.)

Light Spectrum Newsletter
Box 215-DS
Kootenai, ID 83840 (Published by Kootenai Radio—above—this newsletter gives a lot of information on radio equipment and power generating gear.)

Lindsay Publications
P. O. Box 12
Manteno, IL 60950 (Reprints and original books about alternate energy equipment including books on steam engines, storage batteries, etc.)

M & M Enterprises
Box 64
Island Lake, IL 69942 (Gardening seeds.)

Mellinger's
2310 W. South Range Rd.
North Lima, OH 44452 (Greenhouse supplies and reference materials.)

Michaels of Oregon
Box 13010
Portland, OR 97213 ("Uncle Mike's" inexpensive nylon holsters, belts, magazine pouches, buttpacks, etc.)

Mine Safety Appliances Company
600 Penn. Centre Blvd.
Pittsburgh, PA 15235 (Safety equipment, masks, breathing equipment.)

Navy Arms Company Inc.
689 Bergen Blvd.
Ridgefield, NJ 07657 (Importer of Chinese-made air rifles; source offirearms and military surplus gear.)

Newman's GI Supply
RR #1, Box 782
Augusta, NJ 07822 (Military surplus equipment and sand bags.)

Nitro-Pak
11018 Rosecrans Ave, #300
Norwalk, CA 90650

Omaha Vaccine Company
P.O. Box 7228, 3030 L St.
Omaha, NE 68107 (Insecticides, animal medicines and antibiotics.)

Loompanics Unlimited
P.O. Box 1197
Port Townsend, WA 98368 (Reference, medical, survival, etc., books.)

The Mother Earth News
Box 70
Hendersonville, NC 28791 (Monthly self-sufficiency magazine as well as a number of "how-to" books.)

Paladin Press
P.O. Box 1307
Boulder, CO 80306 (Military, medical, survival books.)

Phoenix Systems, Inc.
P.O. Box 3339
Evergreen, CO 80439 (Radiation detection equipment, military surplus gear, barbed ribbon tape.)

Plessey Controls Limited
Sopers Lane Poole
Dorset, England BH1 7ER (manufacturer of the Plessey PDRM 82A radiation meter)

Preparedness Products
130 S. Redwood Rd.
N. Salt Lake, UT 84054 (Distributor of grain, corn, and beans and other survival supplies.)

Ram-Line
15611 West 6th Ave.
Golden, CO 80401 (Accessories for Mini-14, AR-15, 10/22 and other firearms.)

Seeds of Survival
228 W. North St.
Whitewater, WI 53190 (Gardening seeds.)

SGW (Olympic Arms, Inc.)
624 Old Pacific Hwy. SE
Olympia, WA 98503 (SGW version of the AR-15 plus spare parts for it or the Colt version of the rifle.)

SI Equipment, Ltd.
2322 Artesia Blvd.
Redondo Beach, CA 90278 (Gas masks, freeze-dried/dehydrated foods, etc.)

Sherwood International
18714 Parthenia St.
Northridge, CA 91324 (Military surplus equipment.)

Sierra Supply
P.O. Box 1390
Durango, CO 81301 (M17 masks, Israeli gas masks, M17 filters, accessories for masks, and military surplus equipment.)

Survival Center
5555 Newton Falls Rd.
Ravenna, OH 44266 (Shelter ventilation systems, freeze-dried food, survival equipment, etc.)

Vegetable Seed
Box 192
Madison, GA 30650 (Gardening seeds.)

Victoreen Instrument Division
10101 Woodland Ave.
Cleveland, OH 44104 (Radiation meters, dosimeters, dosimeter chargers.)

EUROPEAN SOURCES OF EQUIPMENT

Because of the interest in surviving a conflict between the NATO and Warsaw Pact forces, many Europeans have taken an active interest in nuclear war and chemical/biological warfare survival equipment. Switzerland has even gone so far as to start a massive program of building shelters for EVERY citizen. These are being made to offer shelter from nuclear blast as well as chemical and biological weapons. Due to this work, a market has been created which has encouraged the growth of companies supplying such equipment. While the equipment is expensive, it is well made. Therefore, the companies are included for readers who have the money to buy the very best. Unless otherwise noted, all the companies listed below are in Switzerland.

Alfred Kaercher GmbH & Co.
Leutenbacher Strasse 30-40
P.O. Box 160

D-7057 Winnenden (High-pressure cleaning and decontamination systems.)

Andair, Ltd.
CH-8450 Andelfingen (NBC filters, ventilating units, etc.)

Artos Lufttechnik
Carl-Diem-Weg
P.O. Box 200905
D-5060 Bergisch Gladbach 2 (Shelter ventilation installations.)

Flodins Filter AB
S-45300 Lysekil (Gas mask filters, filters for shelters.)

Kirchner GmbH
Tirolerstrasse 85
D-7000 Stuttgart 61 (Protective clothing, acid/radiation protective clothing.)

Louis Schleiffer AG
CH-7814 Fieldbach/Zurich (NBC protective clothing.)

Luwa Ag
Kanalstrasse 5
CH-8152 Glattbrugg (Filter and protective systems.)

Trelleborg AB
Division of Skyddsprodukter
Box 24 S-271 00 Ystad SWEDEN (Protective suits and breathing equipment.)

Tesimax-Altinger GmbH
D-7530 Pforzheim
Holderlinstrasse 39 (Protective clothing and decontamination equipment.)

BOOKS FOR FURTHER READING

These books will give you a lot more information on many of the subjects touched on in this book. Most can be ordered from the book companies listed above.

Beard, D.C. **SHELTERS, SHACKS AND SHANTIES.** Port Townsend, WA: Loompanics Unlimited, 1914.

Berkow, Robert, Editor. **THE MERCK MANUAL, 13TH EDITION.** Rahway, NJ: Merck & Co., 1977.

Benson, Ragnar with Devon Christensen. **LIVE OFF THE LAND IN THE CITY AND COUNTRY**. Boulder, CO: PaladinPress, 1982.

Benson, Ragnar. **SURVIVALIST'S MEDICINE CHEST**. Boulder, CO: Paladin Press, 1982.

Benson, Ragnar. **SURVIVAL RETREAT**. Boulder, CO: Paladin Press, 1983.

Clayton, Dr. Bruce. **FALLOUT SURVIVAL: A GUIDE TO RADIOLOGICAL DEFENSE.** Boulder, CO: Paladin Press, 1984.

Clayton, Dr. Bruce. **LIFE AFTER DOOMSDAY**. Boulder, CO: Paladin Press, 1980.

Dickson, Murray. **WHERE THERE IS NO DENTIST**. Port Townsend, WA: Loompanics Unlimited, 1983.

Ehrlich, Robert. **WAGING NUCLEAR PEACE: THE TECHNOLOGY AND POLITICS OF NUCLEAR WEAPONS**. Albany, NY: State University of New York Press, 1985.

Felder, David W. **THE BEST INVESTMENT**. Port Townsend, WA: Loompanics Unlimited, 1983.

Glasstone, Samuel and Philip J. Dolan, eds. **THE EFFECTS OF NUCLEAR WEAPONS.** Washington, DC: US Departments of Defense and Energy, 1977.

HENLEY'S TWENTIETH CENTURY BOOK OF TEN THOUSAND RECIPES, FORMULAS, AND PROCESSES. Port Townsend, WA: Loompanics Unlimited, 1977.

Howard, David A. **THE SURVIVAL CHEMIST**. Miami, FL: J. Flores Publications, 1988.

Johnson, Emil R. **FUR, FOOD, AND SURVIVAL**. Miami, FL: J. Flores Publications, 1988.

Kains, M. G. **FIVE ACRES AND INDEPENDENCE**. New York: Dover Publications, Inc., 1973.

Kern, Ken. **THE OWNER-BUILT HOME.** New York: Charles Scribner's Sons, 1972.

Kern, Ken and Barbara. **THE OWNER-BUILT HOMESTEAD.** New York: Charles Scribner's Sons, 1974.

Kearny, Cresson H. **NUCLEAR WAR SURVIVAL SKILLS.** Port Townsend, WA: Loompanics Unlimited, 1987 edition.

Klinghoffer, Max, M.D. **TRIAGE: EMERGENCY CARE HAND-BOOK.** Lancaster, PA: Technomic Publishing Company, 1985.

Leckie, Jim, Gil Masters, Harry Whitehouse, and Lily Young. **MORE OTHER HOMES AND GARBAGE.** San Francisco: Sierra Club Books, 1981.

Long, Duncan. **THE AR-15/M16: A PRACTICAL GUIDE.** Boulder, CO: Paladin Press, 1984.

Long, Duncan. **AR-15: SUPER SYSTEMS.** Boulder, CO: Paladin Press, 1989.

Long, Duncan. **ASSAULT PISTOLS RIFLES AND SUBMACHINE GUNS.** Boulder, CO: Paladin Press, 1986.

Long, Duncan. **AUTOMATICS.** Boulder, CO: Paladin Press, 1987.

Long, Duncan. **COMBAT AMMUNITION: EVERYTHING YOU NEED TO KNOW.** Boulder, CO: Paladin Press, 1986.

Long, Duncan. **FIREARMS FOR SURVIVAL.** Boulder, CO: Paladin Press, 1987.

Long, Duncan. **HOW TO SURVIVE A NUCLEAR ACCIDENT.** Port Townsend, WA: Loompanics Unlimited, 1988.

Long, Duncan. **MODERN BALLISTIC ARMOR.** Boulder, CO: Paladin Press, 1986.

Long, Duncan. **THE RUGER 10/22 AND .44 CARBINE.** Boulder, CO: Paladin Press, 1988.

Long, Duncan. **STREETSWEEPERS: THE COMPLETE BOOK OF COMBAT SHOTGUNS.** Boulder, CO: Paladin Press, 1986.

Long, Duncan. **SURVIVAL BARTERING.** Port Townsend, WA: Loompanics Unlimited, 1981.

Long, Duncan. **SURVIVING MAJOR CHEMICAL ACCIDENTS AND C/B WARFARE.** Port Townsend, WA: Loompanics Unlimited, 1986.

Mason, Rosalie. **BEGINNERS GUIDE TO FAMILY PREPAREDNESS.** Bountiful, UT: Horizon Publishers & Distributors, 1977.

Nelson, Louise. **PROJECT READINESS.** Bountiful, UT: Horizon Publishers & Distributors, 1974.

Peterson, Franklynn. **HOW TO FIX DAMN NEAR EVERYTHING.** Port Townsend, WA: Loompanics Unlimited, 1977.

Royal United Services Institute for Defence Studies. **NUCLEAR ATTACK: CIVIL DEFENSE ASPECTS OF CIVIL DEFENCE IN THE NUCLEAR AGE.** Fairview Park, Elmsford, NY: Brasseys, 1985.

Resh, Dr. Howard M. **HYDROPONIC FOOD PRODUCTION.** Santa Barbara, CA: Woodbridge Press (Box 6189), 1981.

Rexer, Jr., Fred. **BRASS KNUCKLE BIBLE.** Port Townsend, WA: Loompanics Unlimited, 1978.

Robinson, Arthur B. and Gary North. **FIGHTING CHANCE.** Cave Junction, OR: Oregon Institute of Science and Medicine, 1987.

Saxon, Kurt. **SURVIVAL FOODS, PLUS.** Harrison, AR: Atlan Formularies, 1977.

Saxon, Kurt. **THE SURVIVOR (Vols. I-VI).** Harrison, AR: Atlan Formularies, 1976, 1977, 1978, 1979, 1986, 1988.

Skousen, Joel. M. **THE SURVIVAL HOME MANUAL.** Port Townsend, WA: Loompanics Unlimited, 1982.

Spigarelli, Jack A. **CRISIS PREPAREDNESS HANDBOOK.** Provo, UT: Resource Publications, 1984.

Starr, Gary. **THE SOLAR ELECTRIC BOOK.** Port Townsend, WA: Loompanics Unlimited, 1987.

US ARMY'S SPECIAL FORCES MEDICAL HANDBOOK (reprint). Boulder, CO: Paladin Press, 1982.

US Navy. **BASIC CONSTRUCTION TECHNIQUES FOR HOUSES AND SMALL BUILDINGS SIMPLY EXPLAINED.** New York: Dover Publications, Inc., 1972.

Werner, David. **WHERE THERE IS NO DOCTOR.** Port Townsend, WA: Loompanics Unlimited, 1977.

OTHER TITLES

☐ **FULL-AUTO!** Newly updated edition! Complete illustrated manual on selective fire conversions for the following weapons. MINI-14, AR-15, HK 91, HK-93 MAC-10, MAC-11, and the M1 CARBINE.
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☐ **PYROTECHNICS.** With over 245 pages,this monumental work places in the hands of the beginner a working manual which will assist greatly in the production of every known piece of fireworks.
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☐ **FUR, FOOD AND SURVIVAL.** The most complete book ever written on the subject of trapping! Details modern trapping methods as well as snaring and deadfalls methods useful in survival conditions. How to build your own inexpensive traps, snares and deadfalls is also shown in detailed, illustrated construction plans.
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